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Gas Journal

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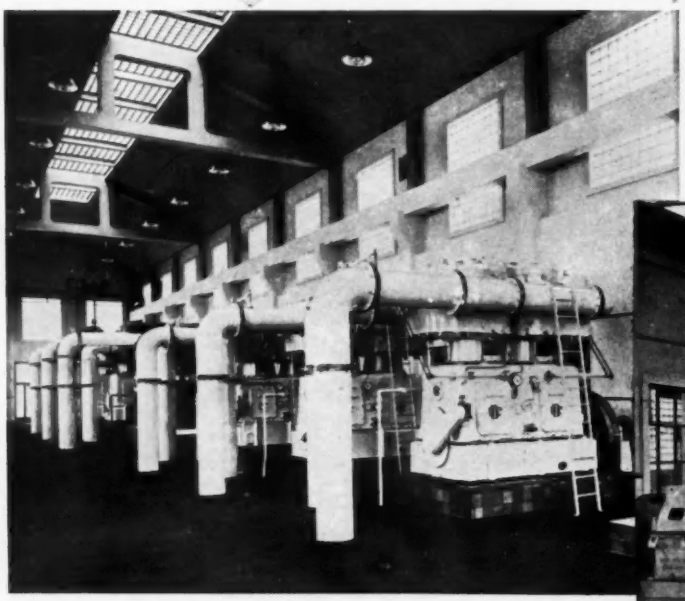

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Illustrations show the interior of the Compressor House comprising:
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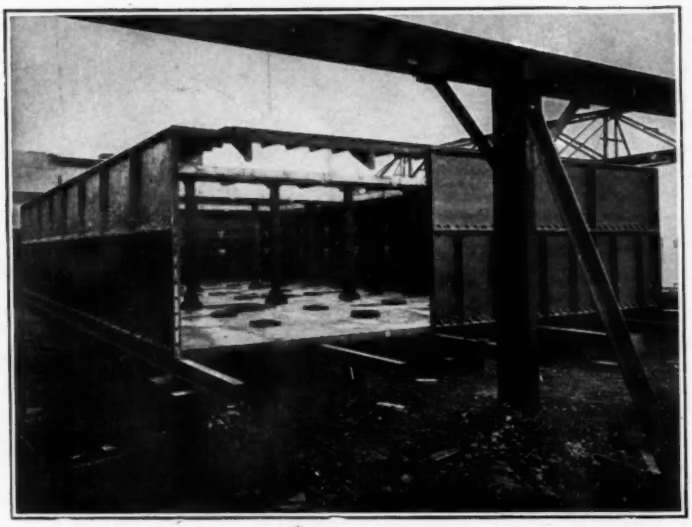

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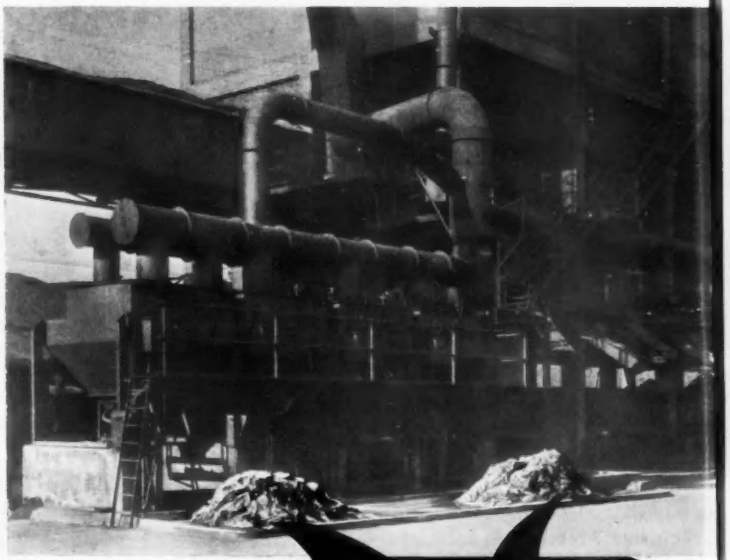

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Florence	2	3,780,000
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Montlucon	2	2,500,000
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Nortorf	1	100,000
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Philippeville	1	420,000
Point of Ayr	**1**	**1,500,000**
Portsmouth	**1**	**2,000,000**
Quimper	2	2,500,000
Romford	**2**	**4,000,000**
Sao Paulo	1	100,000
Sheffield	**2**	**10,000,000**
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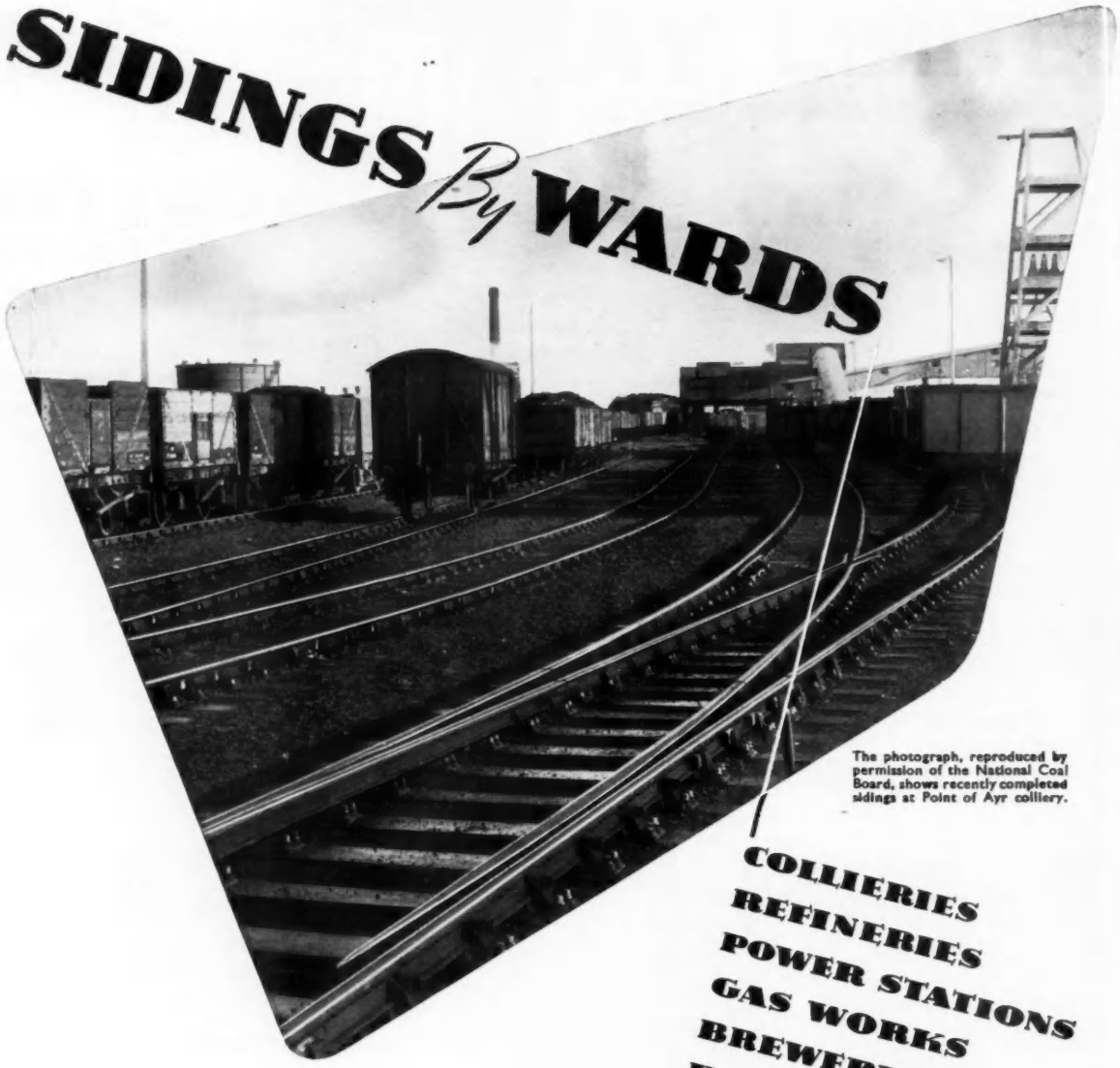

The photograph, reproduced by permission of the National Coal Board, shows recently completed sidings at Point of Ayr colliery.

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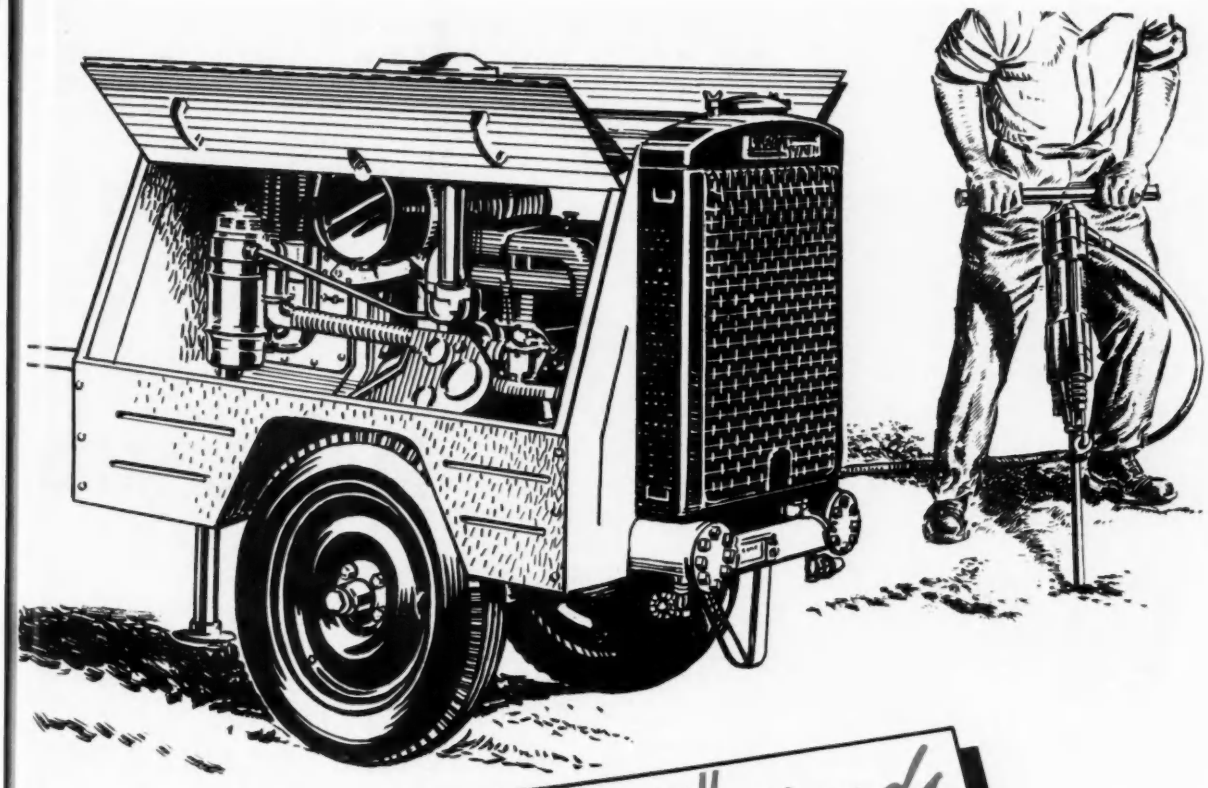

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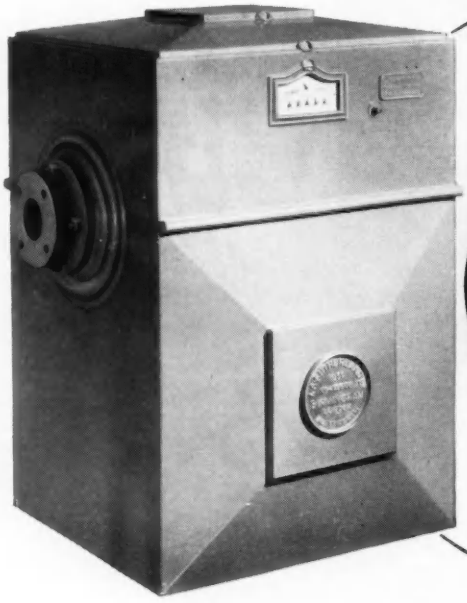

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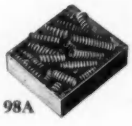
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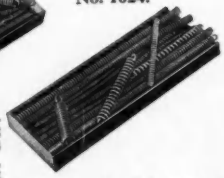

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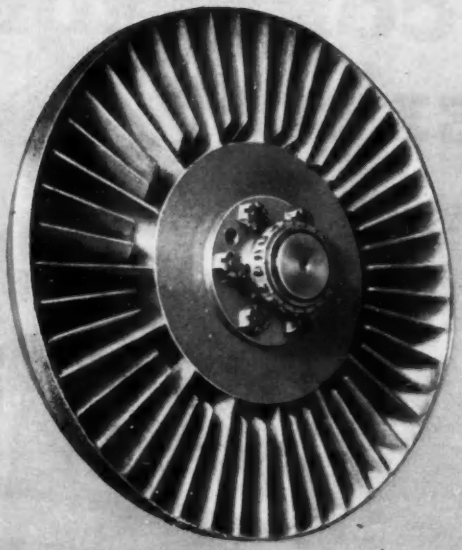

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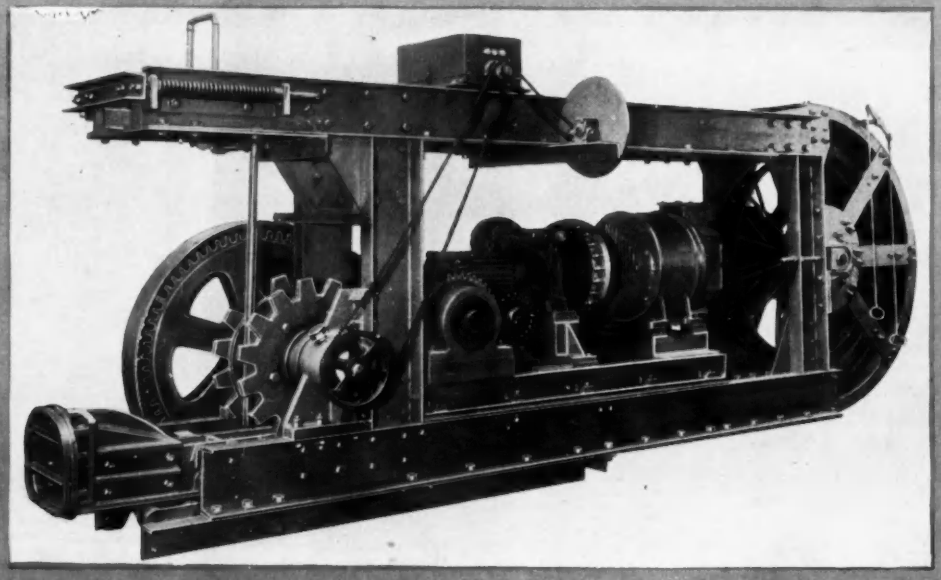

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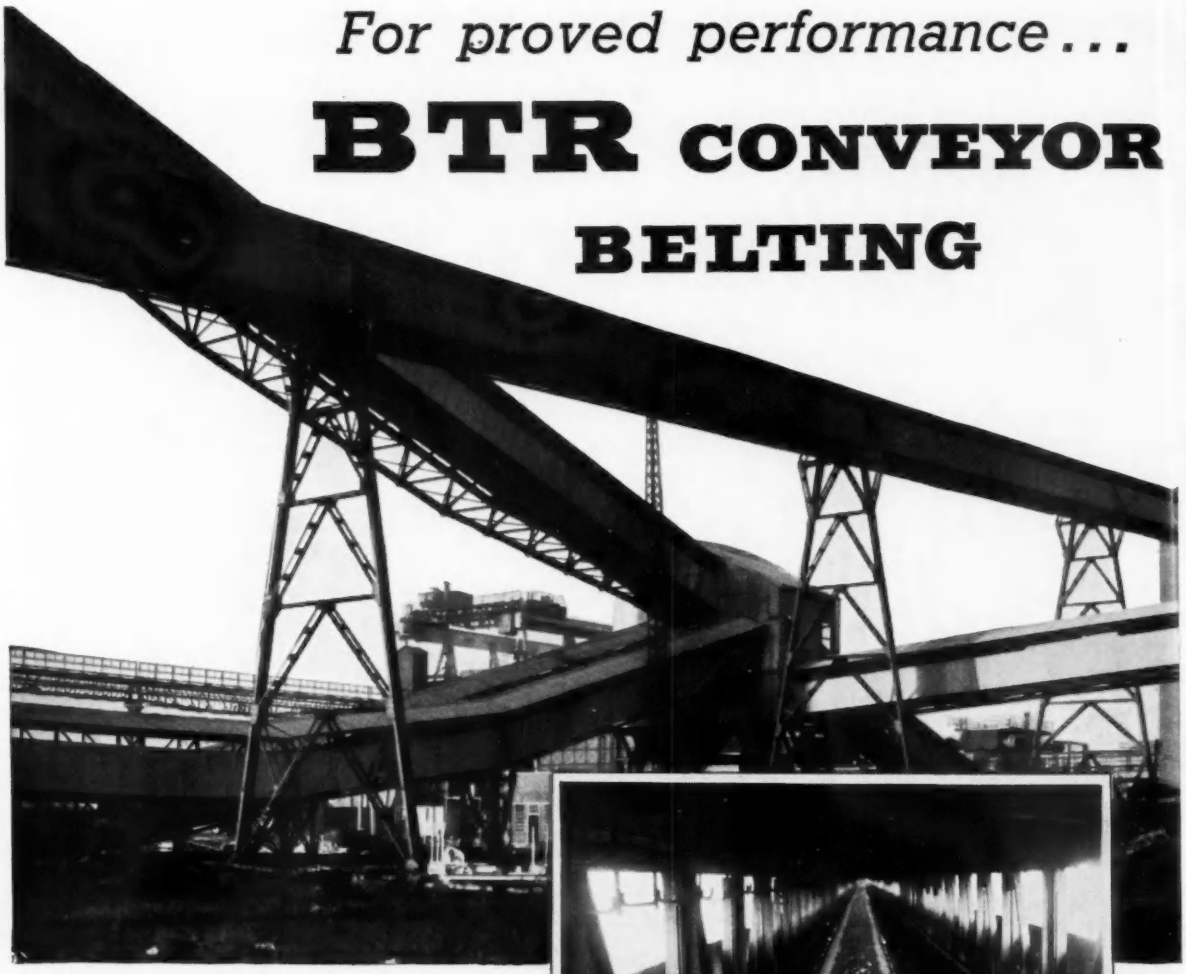

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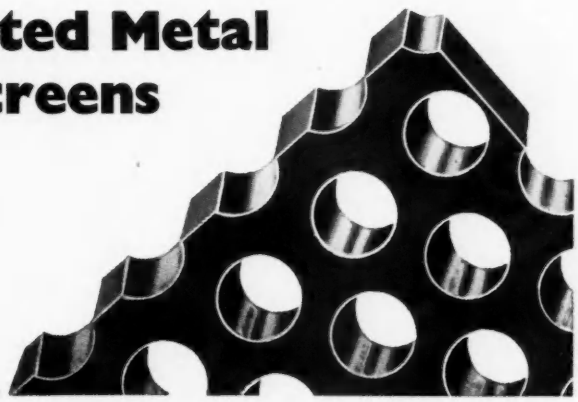

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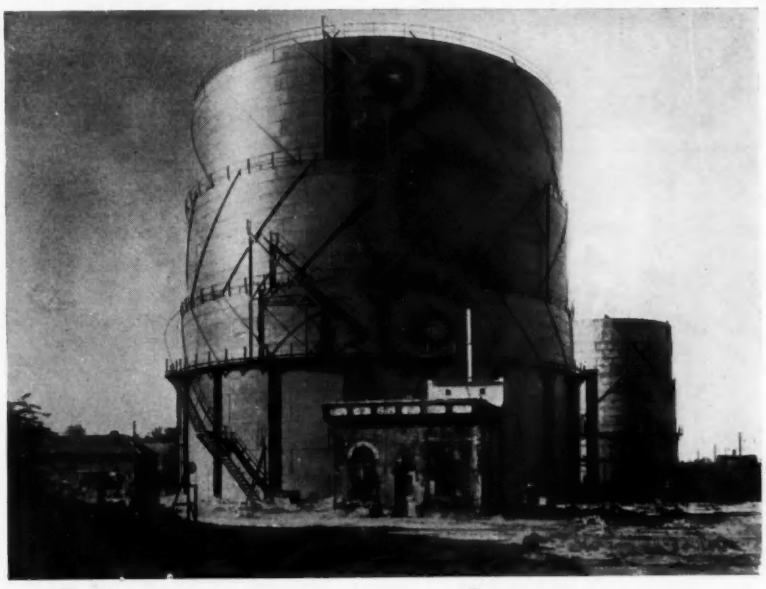

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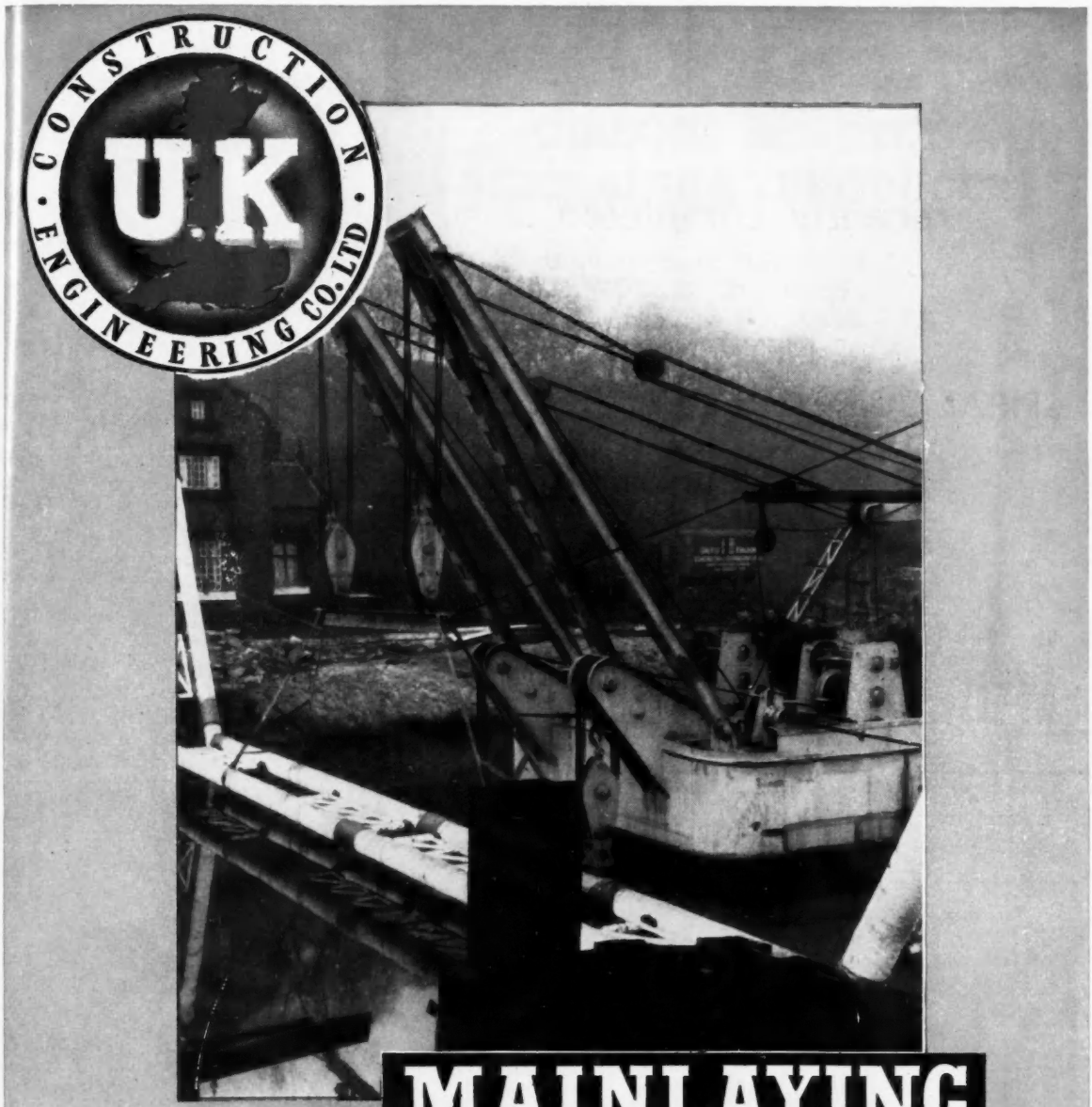

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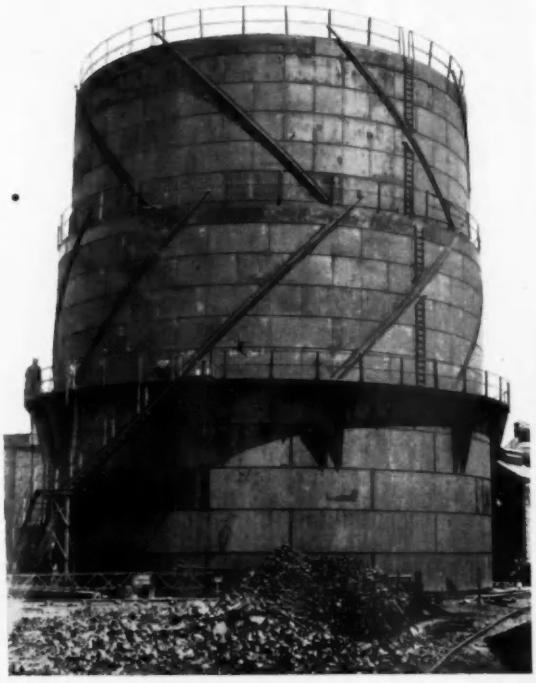

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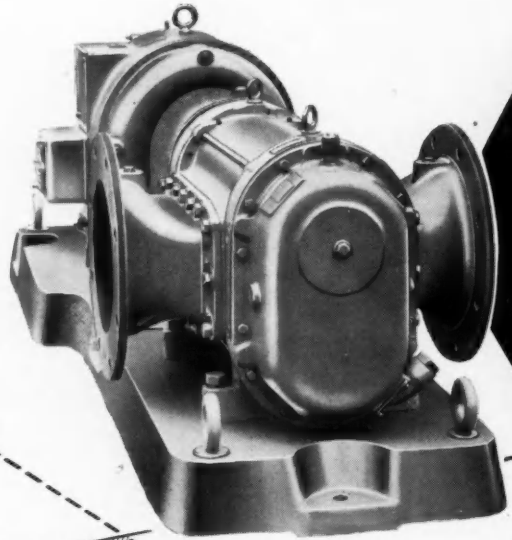

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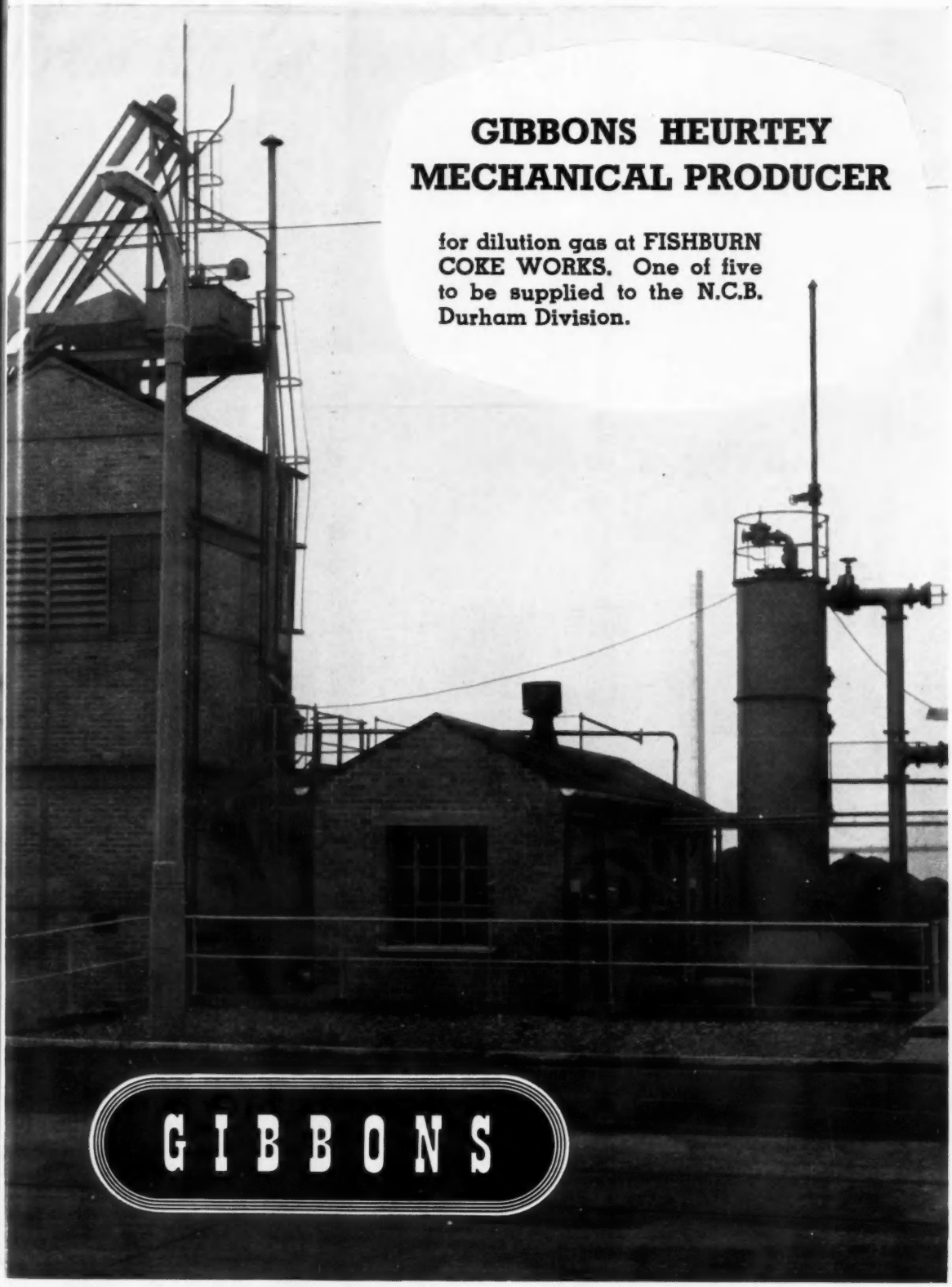
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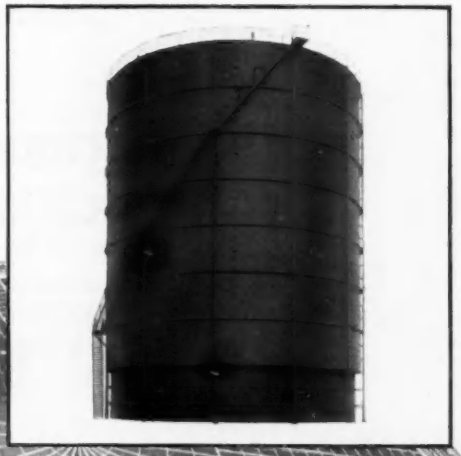

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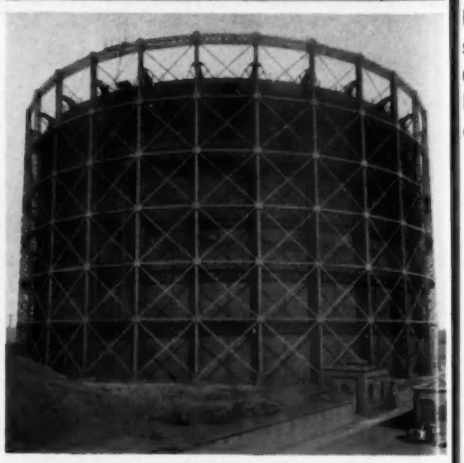

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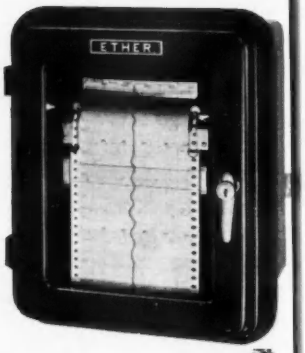

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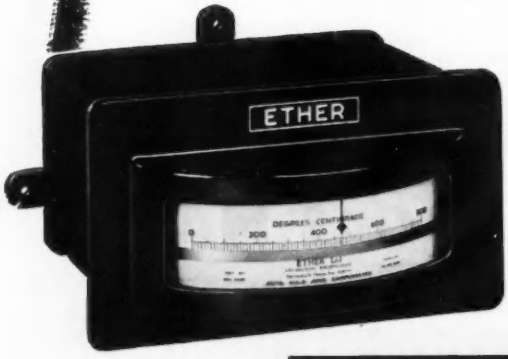

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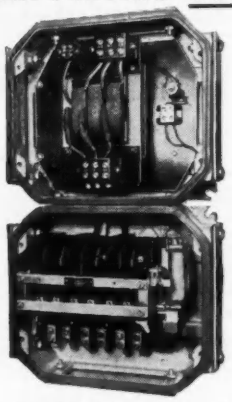

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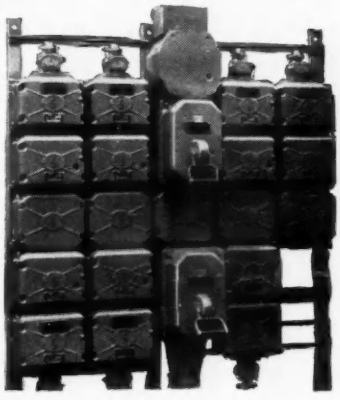

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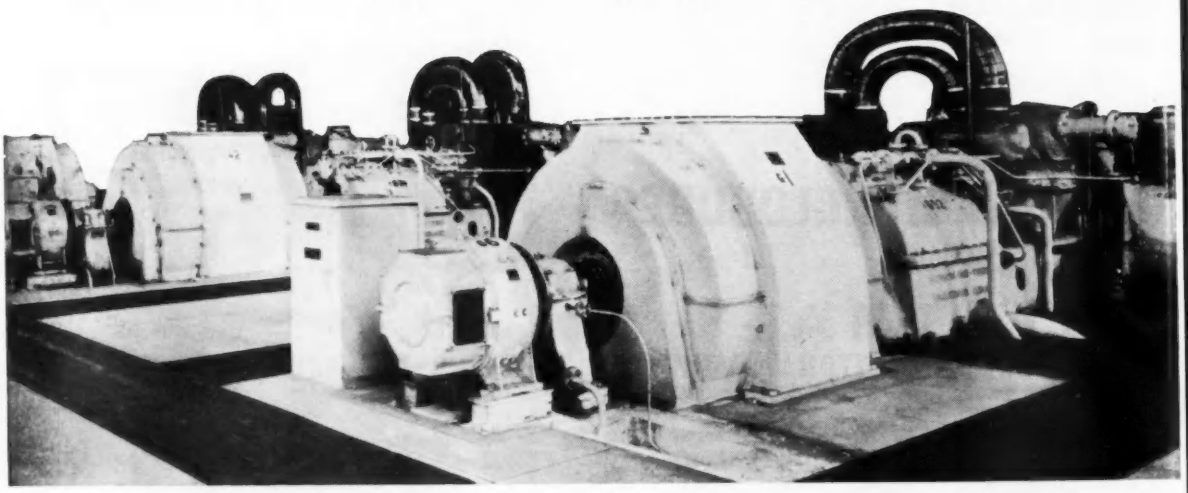

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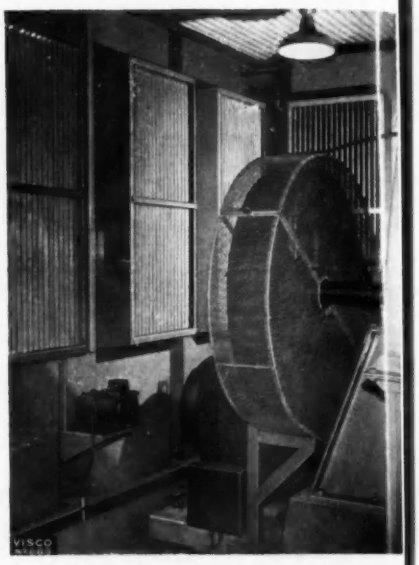

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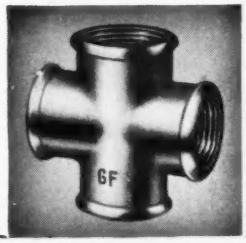

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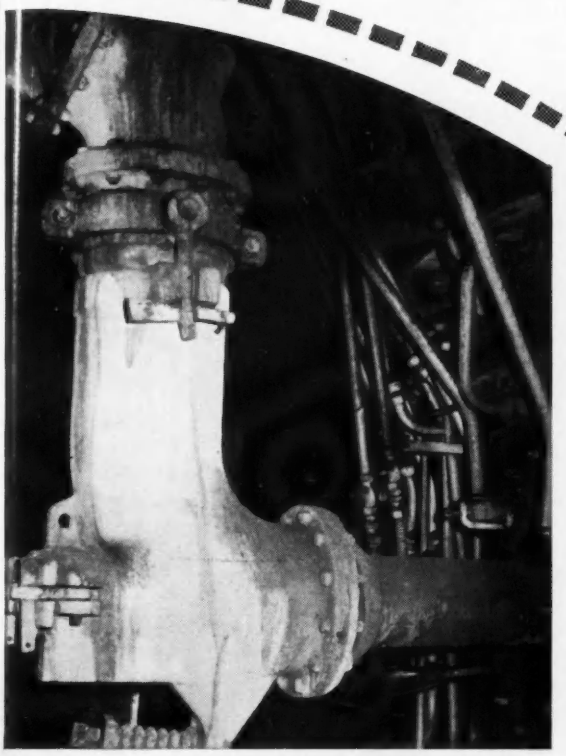
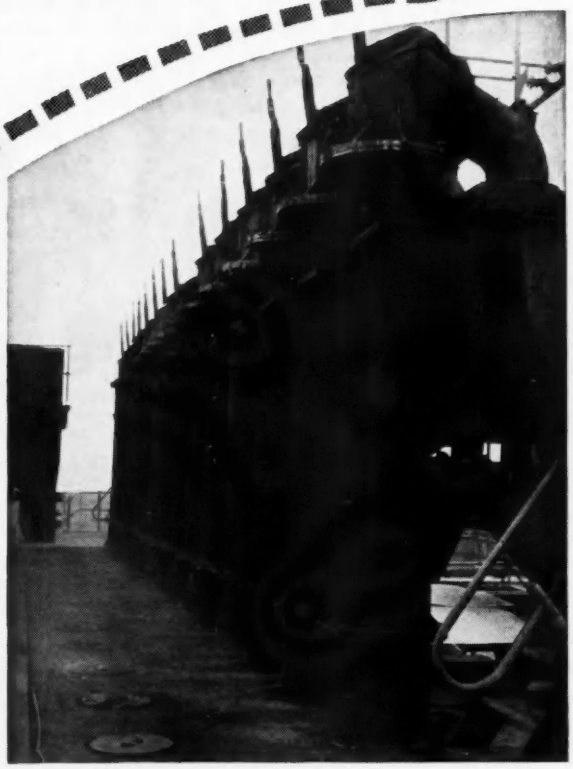


Refractory Concrete-lined Goose necks in position on blast furnace from bustle pipe to tuyere



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Coke oven ascension pipes showing Refractory Concrete lining.

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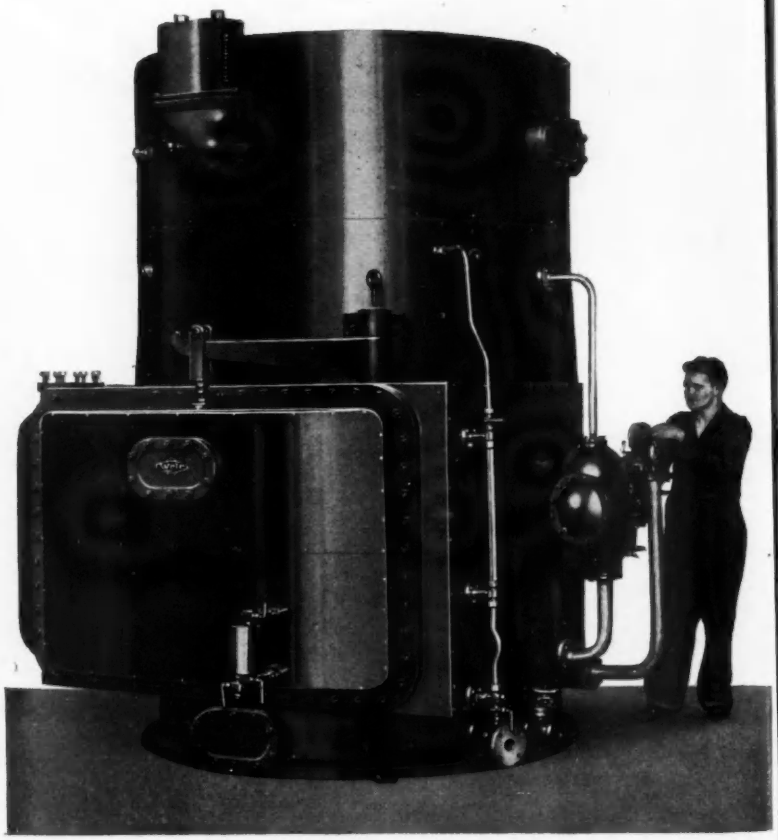

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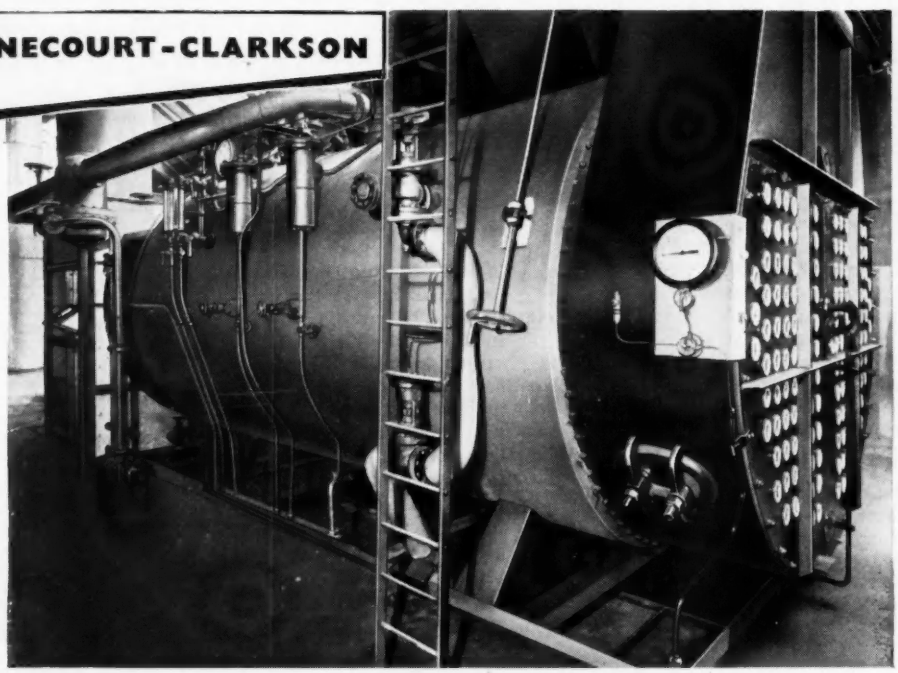

The illustration shows one of the Spencer-Bonecourt waste-heat boilers at Stoke-on-Trent Gas Works. Similar units are installed on all the Glover-West Continuous Vertical carbonising plant in this works.

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NEW APPROACH TO WAGON HANDLING

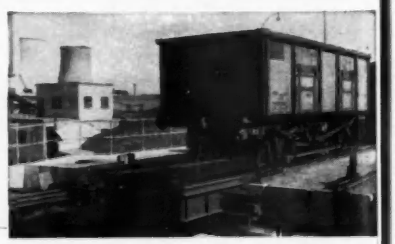
. . . Mitchell system means smaller sidings, quicker turnround, less gear, greater safety

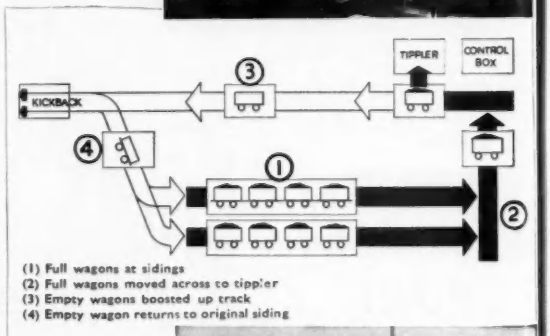
How many men work on your coal sidings? How many locomotives or capstans? What space is wasted by sprawling tracks? How much tonnage can you handle per hour?

The generally unsatisfactory answers given to such questions as these inspired the design of the Mitchell system of wagon handling — a mechanical, electrically-controlled system that offers remarkable scope for increased efficiency at power stations, collieries, coal preparation plants, steelworks, etc., and other centres of industry possessing marshalling yards.

The Mitchell system can be operated by two men. It takes wagons from the arrival sidings, loads or unloads them, weighs them and re-marshals ready for departure. Wagons can be emptied and returned to the same siding they arrived at "full" so that one track is used for full and empty wagons. No internal shunting, no additional motive units, no man-handling other than initial uncoupling and final recoupling, are required. The system has no limit to size or capacity and can easily handle the 1000 tons or more of coal per hour which is now being called for. And it does it with the highest degree of safety, in all weathers, round the clock if needs be.

By demanding no more than half the space occupied by traditional balloon sidings, the Mitchell system makes possible the erection of new plant on sites hitherto unsuitable, with very large savings in initial and later costs. Its flexibility makes it adaptable to any individual handling problem. Installations are already at work for the National Coal Board and the British Electricity Authority. The thoroughgoing efficiency and economy of the Mitchell system puts it far in advance of any traditional method and establishes it as the system of the future.





(1) Full wagons at sidings
(2) Full wagons moved across to tippler
(3) Empty wagons boosted up track
(4) Empty wagon returns to original siding

An installation at the British Electricity Authority Freemens Meadows, Leicester, handling 800 tons of coal an hour. The site is limited in area and normal methods of working with balloon sidings would be impractical. The pictures show the traverser pulling an incoming truck on to the transfer rail and an emptied wagon being returned to the siding by the 'kickback'.

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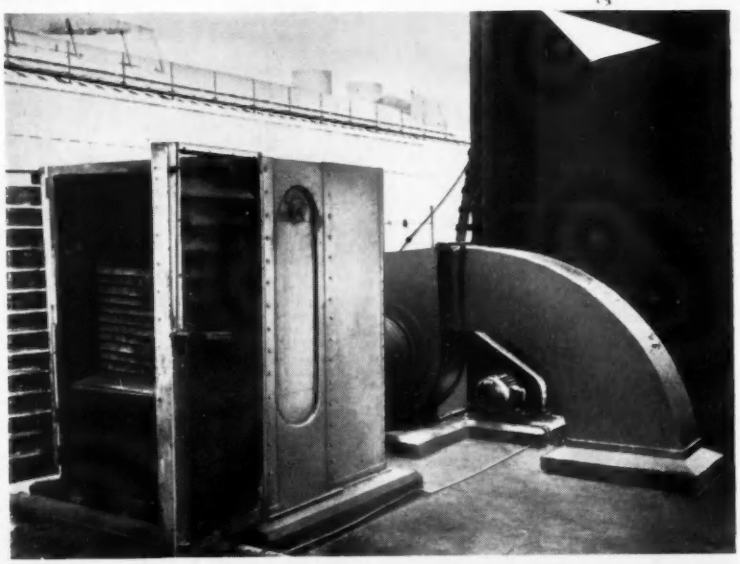

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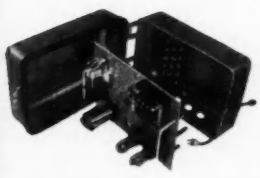

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Gas Journal

VOL. 286 NO. 4849 June 20, 1956

108TH YEAR

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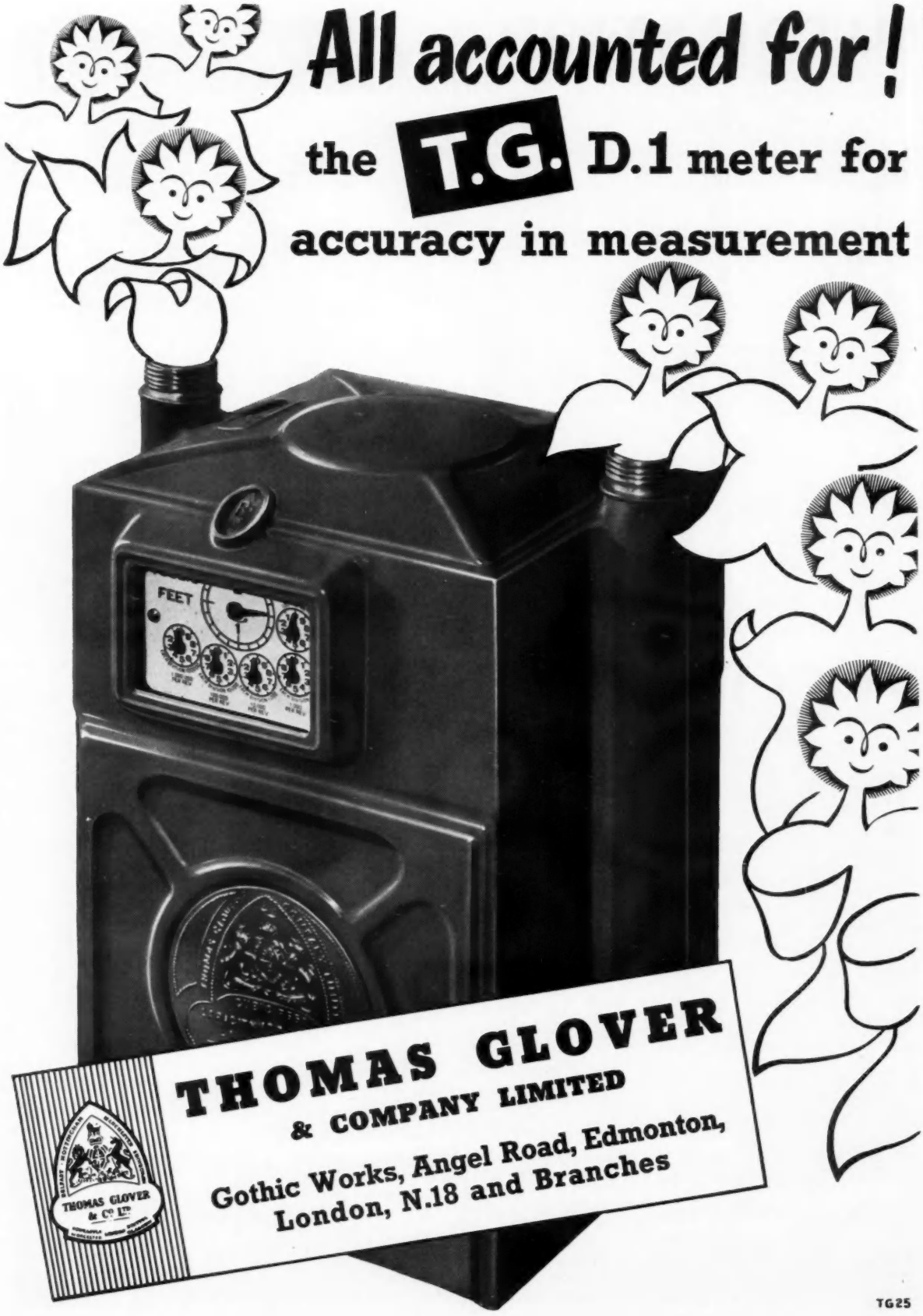

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Gas Journal

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A Pattern of Power

WHEN, on Sunday, the fifth World Power Conference opened in the State Opera House, Vienna, there began to emerge from the thousands of words and the variety of tongues perhaps the most definite outline of a future power pattern yet to be glimpsed by those who peer ahead so eagerly and anxiously. In due course we shall examine some of the papers, but for the moment let us content ourselves with the remarks passed by the President of the Conference, Sir Harold Hartley, who, with a clear grasp of the essentials and a pretty turn of phrase, indicated the extent and nature of the fuel and power problem which confronts the civilized world and perhaps ourselves more than most.

The unprecedented advance in man's understanding of nature, achieved in spite of (or because of?) the catastrophe of war has, in Sir Harold's words, 'placed in the hands of mankind a new source of power and vast new possibilities of a closer partnership with nature and of all that that implies.'

At the same time the world's needs and the world's desires are increasing even faster. The discovery of the possibility of harnessing nuclear energy has come at a most timely moment. The nuclear energy available in uranium and thorium has multiplied the energy resources of the world many fold. It will in time make ample supplies of energy available at places where the cost of transport of traditional fuels might be prohibitive.

Now, with a sharing of the task of design and construction of nuclear reactors, it is possible to 'see the position in better perspective and estimate the probable time-scale of nuclear development.' But, of course, there are still many problems to be solved. The construction of a reactor calls for new standards of accuracy and reliability of engineering. Much has still to be learnt about the behaviour of materials under prolonged and intensive irradiation. The demand for electricity is growing continuously, and by 1975 perhaps as much as 50% of the intake of energy may be distributed in this form. Nuclear power stations will soon begin to take the place of what are essentially fossil fuels—coal, oil and natural gas—now being burnt under boilers, when these will be needed badly for other purposes, for many of which nuclear power could not replace them. For as Sir Harold says, 'One thing is certain—with the world's hunger for energy every form that can be used economically will be required.'

He went on to say that with the world's demands for energy in the years to come each country will find the need for an energy policy, and it seemed inevitable that the energy industries must seek among themselves for the best means of meeting those energy demands in the most efficient and economical manner, 'consistent always with that almost sacred condition, the consumer's freedom of choice.'

Sir Harold Hartley was also chairman of the O.E.E.C. Commission responsible for the enquiry into the problem 'Europe's growing needs of energy—how can they be met?' the report of which has just been published. The report brings out very strongly the similarities between the United Kingdom's energy problems and those of other Western European countries. It is interesting to note that it fully confirms the view of the British Government (expressed, for instance, in the Second Reading Debate on the Coal Industry Bill on May 10) that coal will be the mainstay of our energy supplies for many years yet. A particularly important point is the Commission's forthright emphasis on the need for 'giving coal the outlook of a modernized, stable industry which will attract able young men to join it.' The popular view that coal is a dying industry is demolished thoroughly and decisively and a warning is given against the 'popular misconception that nuclear energy will make large contributions in the near future.' Though it does not underestimate the growing part which nuclear energy will play—and the United Kingdom of course, is a leader in this field—the Commission estimates that this contribution will not exceed a figure of 80 mill. tons coal equivalent by 1975—less than 8% of total requirements of the O.E.E.C. countries.

The Commission calls for a determined effort among

O.E.E.C. countries to develop further their indigenous production of all forms of energy. Additional effort should be devoted to the harnessing of undeveloped sources of hydro-power and to the search for new sources of oil and natural gas. The Commission also attaches special importance to the up-grading of primary into secondary forms of energy, such as gas and electricity. The availability of these secondary forms is considered to be essential to a rise in the productivity of many industries and is also a condition for improved standards of living. Again it is emphasized that competition should be allowed to play its full role in giving the consumer a maximum choice between the different forms of energy.

Dealing with the energy position in the United Kingdom the report points out that coal represents 99% of the total indigenous output of energy and, despite substantial imports of petroleum, coal still represents 86% of total energy consumption. The U.K. is the largest producer of coal in Western Europe and the third largest in the world. It also leads the European countries in the production of electricity and holds third place in the world after the U.S.A. and Russia. As the report points out, despite the ambitious nuclear programme it is likely that in the next 20 years the U.K. will be obliged to maintain and even increase its output of coal and to make use of substantial quantities of petroleum.

The Future for Coal

A warning against the belief that the coal industry might decline as a result of the advent of nuclear energy is given in the O.E.E.C. Coal Committee's annual report 'The Coal Industry in Europe,' 1955. Far from supplanting traditional sources of energy, the report states, nuclear power would immediately have to supplement them in order to face a constantly increasing demand. It would be a dangerous error to think that coal, considered as the least adaptable of traditional fuels, would be reduced to a stop-gap, as such a view might cause producers to restrict or suspend their long-term investment programme and this, in the view of the Coal Committee, could only provoke a future fuel crisis more serious than any which had yet been known.

Dealing with the trend of the coal market during 1955 for the member countries of the O.E.E.C. as a whole, the report states that demand increased by 23 mill. tons, compared with 1954, but production rose by only 2.5 mill. tons. This resulted in a reduction of 4.5 mill. tons in pithead stocks and, at the same time, a substantial rise in imports from the United States, which reached 25 mill. tons.

The sectors which contributed to increased consumption were principally the iron and steel industry—the great activity of which called for a heavy consumption of coal in coking plants for the manufacture of metallurgical coke—followed by electric power stations. The demand by transport and household consumers remained practically stable. In spite of rising demand prices remained approximately stable, at least within the coal and steel community. Certain changes which occurred in trade in the O.E.E.C. area were primarily due to reductions in United Kingdom exports as a result of increased demands from the home market.

The Committee think that the demand for coal might increase again in 1956 but at a slower rate than in 1955. In the longer term the increase in energy requirements was likely to continue, an increased demand for solid fuels being a natural corollary. At the same time new prospects were opened for the coal industry in the chemical treatment of coal and total gasification.

Dry Cooling of Coke

APART from whatever saving it can show in money and in coal the dry cooling of coke seems to be the only way in which intermittent systems can be brought into line with modern ideas of smokeless carbonization. The steam rising from wet quenching has not only an acid content but, like that rising from the cooling towers of the electricity generating station, it carries a not entirely negligible quantity of solid matter in suspension, which even though the steam is discharged 'at a sufficient height' eventually settles out over the countryside to the general detriment. Even when power stations are sited well out in the country this nuisance is not negligible and the same applies to carbonizing plant.

All this is not in contradiction of the view expressed by Mr. A. E. Morris in his paper to the Institution (abstract published on p. 747, June 6 issue) that the fundamental function of coke dry cooling is to recover waste heat. 'Some 25% of the heat which is used for carbonizing in static plants is discharged from the plant as sensible heat in the coke, which in wet quenching systems is dissipated in the useless evaporation of approximately half a ton of water per ton of coke cooled.'

Dry cooling is effected by the circulation of inert gases which take up the heat from the coke and transfer it to a waste-heat boiler plant. The interesting point is that the 'inert gases' are none other than ordinary atmospheric air which speedily becomes 'inert' by combination of the oxygen with a very small fraction of the carbon, adding thereby a little to its heat content, and as the system is virtually a closed one, this only occurs in the initial stages.

The net result is, in round figures, 1,000 lb. of steam raised per ton of coke cooled. But there are other, subtler, advantages. In any system of wet quenching applied to coke direct from the carbonizing chamber—and this includes the use of water sprays in the coke receiving chambers of continuous verticals—the dust tends to stick to the larger pieces of coke. This condition persists through the screening plant and gives rise to dust nuisance in the consumer's store. The effective removal of this fine dust at an early stage is, indeed, 'an obvious advantage,' not only in producing a de-dusted breeze which can be more readily gasified in producers but in the popularization of coke as a domestic fuel. With this dust removed there is no great objection to the addition, later, of a controlled amount of water.

The suggestion that when coal-blending becomes more general—and it would seem that this is inevitable in the near future—the fine coke dust should be included in the blend is one which, when the time comes, should not be lost sight of. One other point of great importance in the domestic use of coke is the claim that dry-cooled coke is free from fliers.

But Mr. Morris does not shirk a discussion of the

objections to the system. In the presentation of his paper he selected three points as forming 'the main basis of the reluctance to adopt coke dry cooling.' First he put the water content (or possible absence of it) which can easily be dealt with. Third, the high capital cost of the cooling plant—'but cost is not an "absolute" value, its assessment depends entirely on the financial benefits it does or does not produce,' and in this assessment account must be taken of 'the foreseeable trend.' The other objection is 'the addition of another operation in the gas-making sequence with consequent possibility of interruption.' This, he suggests, can be overcome by the provision of simple standby wet quenching plant. But could it not be overcome, in these days of big units, by the sub-division of the plant into sections so that interruption would be localized, dealt with by the interruption of operations in the one section where the difficulty may occur? Mr. Morris mentions several other objections which have been raised but to all of them he has satisfactory answers.

A Time for Re-examination

Mr. Morris's paper is a useful compendium with critical appraisals of the several methods which have been developed or proposed for the dry cooling of coke with a bibliography of extant literature on the subject which considerably enhances its value as reference. The two main systems, the Sulzer and the Collin, are differentiated by the method of transferring the hot coke from the carbonizing chamber to the cooling chamber. In the former it is transferred in some form of intermediate skip or other container which is discharged or wheeled into the cooling chamber; in the latter it is discharged direct. In both systems the coolant is the mixture of circulating inert gases. There is a variant in the second system in the two forms of static verticals, in which the hot coke is dropped into a vessel placed directly below and in direct communication with the vertical retort above and in which the coolant is steam. Mr. Morris uses the term 'integral cooling' to cover these. 'No attempt is made to compare (these systems) with the fundamentally different process of recovering the residual heat of coke (mainly—though we should say, not entirely—by steam) in the continuous vertical retort.

We submit that Mr. Morris has proved his case that the time has come for a re-examination of the economics of coke dry cooling, whether applied to coke ovens, intermittent vertical chambers or even horizontal retorts, a re-examination the urgency of which is underlined by the present and prospective fuel positions.

Contributions to the discussion were of a very high order. It was inevitable that the economics of the process loomed large. Dr. Foxwell remarked upon its 'depressing history' but he concurred in the advantage that 'only dry coke could be accurately sized,' against which Mr. Townend pointed out the difficulty of dealing with 'absolutely bone-dry coke without creating a dual nuisance.' There was emphasis upon the cost and difficulty of maintenance and upon the capital cost. Mr. Dougill made the interesting point that cooling was only carried down to 300°C.. He was emphatic that 'Contractors would have to consider a plant from 950°C. to the customer. . . . Coke at 300°C. passed to an ordinary screening plant was simply asking for trouble' —to which it might be replied that from continuous verticals without the water spray something very like this has been done for a very long time without any difficulty.

A New Mrs. America

REMEMBER the charming Mrs. C. Dietemeyer (alias 'Mrs. America') who made quite an impression on some of our delegates to the I.G.U. meeting last year whom we were glad to welcome over here in December? Her term of office has expired and she is to be replaced. Judges for this year's contest to find the new 'Mrs. America' are Marian Manners, home service director and special feature writer for the Los Angeles *Times;* Josephine McCarthy, director of home economics for the National Broadcasting Co.; Arthur William Brown, well-known illustrator; Russell Patterson, artist and interior decorator; Isabel McGovern, director of the *Herald-Tribune,* kitchen and special food writer; Mary Rokahr, head of the Department of Home Management, School of Home Economics, University of Connecticut; and Iris Davenport, editor, women's department, *Farm and Ranch* magazine.

'Mrs. America' will be judged on her home-making abilities, attractive appearance and active participation in church and community affairs. To make certain that these requirements, rather than beauty, are strictly adhered to, each contestant is carefully screened at the local, state and national level, before the final selection is made.

Gas companies have distributed more than 250,000 entry blanks. City, county, and state homemaking contests, consisting of cooking, baking, menu-planning, sewing, washing and ironing competitions, are held throughout the country in gas company auditoriums.

These state finalists and their husbands live in identical homes on Mrs. America Drive at Ellinor Village, Fla., during the finals. Daily assignments are given over a five day period during which time the panel of seven judges observe contestants' home-making abilities, rating them individually on food preparation, menu planning, and general housekeeping. Neatness and careful grooming, rather than beauty and sex appeal, are what the judges look for. Between assignments, contestants and their husbands are entertained at teas, parties, dances and banquets. Swimming and golf are among the favourite recreational activities. Plenty of time, however, is allowed for rest.

The new Mrs. America will appear at home shows, conventions, and on radio and TV throughout the year. She will typify the American wife and mother who manages a happy home, raises a family, participates in community affairs and maintains her attractive appearance at all times.

Among the many valuable prizes that will be hers are a New Freedom gas kitchen and laundry, a two-week vacation at Ellinor Village with her husband and children, a four-week vacation in Europe with her husband, a new DeSoto car, and additional prizes of clothing, food and equipment. These prizes plus personal appearance fees will come to more than $20,000.

The publicity value to the American gas industry is unquestionable, and we cannot help wondering whether our own gas industry might consider selecting a 'Mrs. Britain.' Unlike the 'Bride of the Year' and similar competitions, the value would lie not just in publicity resulting from the selection of the most suitable candidate, but in the creation of a national figure, an ambassadress of goodwill for the industry. If we *must* have competitions let us aim for lasting benefits.

Personal Notes

MR. R. B. GARSIDE, who has been Gas Distribution Engineer to the Karachi Gas Company, Limited, since its formation has resigned the post and returned to the U.K. He was formerly with the Sui Gas Transmission Co. Ltd., in Karachi, engaged on the distribution and utilization of natural gas supplies. Mr. Garside was formerly Engineer and Manager of the Thornton Cleveleys and Caernarvon gas undertakings and has held appointments with the Grantham, Kendal, Keighley and Morecambe gas undertakings.

MR. MICHAEL F. KELLY, of Mackay Industrial Equipment, Ltd., has been appointed south eastern area Tractor Representative. After attending the London School of Economics, Mr. Kelly joined Mackay in 1951 as a clerk. He later became Assistant Publicity Manager and in this capacity, as a result of his visiting sites throughout the country, he is already known to many of our readers.

MR. PETER MASON, Local Superintendent of the Kibworth undertakings, Leicester Group, East Midlands Gas Board, for nearly 50 years, received a presentation from his friends in the Leicester and Northants Division and from employees at Kibworth. Mr. Mason, who is 77, started work in the gas industry 65 years ago.

MR. W. G. P. FRASER has been appointed to the Board of Directors of Mavor & Coulson, Ltd., with effect July 1, 1956. Mr. Fraser joined the company in 1946, and since 1947 has been their Accountant. He is also a director of their subsidiary company, Mavor & Coulson (South Africa) Ltd.

MR. P. R. TOZER, until recently an engineering assistant (distribution) with the South Western Gas Board at Torquay, received a Commission with the Royal Electrical and Mechanical Engineers at Havannah Barracks, Bordon, Hants, on June 9. As senior officer cadet he received a silver-mounted cane.

MR. W. P. MITCHELL, District Manager for the Scottish Gas Board at Stornoway, has been appointed Gas Manager at Elgin.

MR. JAMES G. MCEWAN, Sales Officer for the Alloa-Stirling Sub-Group of the Scottish Gas Board, who has been appointed Divisional Sales and Service Superintendent, of the South East Scotland Division, with headquarters in Edinburgh, takes up his new post on June 18. A Stirlingshire man, he began his career with the old Stirling Gaslight Company in 1933. He took up his present post with the Gas Board in April, 1954. At the moment he is Chairman of the Sales Circle for the Central Division of the Board.

MR. GEORGE EWART has informed Parnall (Yate) Ltd., that he wishes to retire from his whole-time appointment with Ewart & Son Ltd. The Board has assented with regret to Mr. Ewart's request and consequently, while he will remain a non-executive Director of Ewart & Son Ltd., he will cease to have executive responsibilities with effect from July 1, 1956. From the same date, MR. GEORGE BEHR will take over the executive duties as Home Sales Manager of Ewart & Son Ltd., in addition to his present duties.

Obituary

MR. ERIC L. BLACK, Assistant Engineer and Manager at Kidderminster, West Midlands Gas Board, has died in Kidderminster Hospital after being unconscious for five weeks following a fall down the stairs of his home in Chester Road North, Kidderminster. He was 30. Mr. Black entered the gas industry in his native town of Motherwell after war-time aircrew service in the R.A.F., and went to Kidderminster from Dumbarton last November. He leaves a widow.

MR. HORACE T. LONG, of Mill House, Salfords, died on June 14, aged 81 years. In pre-nationalisation days he was Secretary of the East Surrey Gas Company. At the funeral to-day the Evening Star Lodge is represented.

Diary

June 22.—LONDON JUNIORS: Summer Meeting and Ladies' Day. Visit to the Nine Elms Works of the North Thames Gas Board, and a river trip to the Pool of London.

June 26. — LONDON AND SOUTHERN I.G.E.: Summer Meeting, Dover.

June 27.—SOUTH WESTERN SECTION, I.G.E.: Summer Meeting and Ladies' Day, Weston-super-Mare. Followed by visit to Long Ashton Research Station, University of Bristol.

June 29.—INCORPORATED PLANT ENGINEERS: 'Spring Design and the Plant Engineer,' A. A. D. Brown. Imperial Hotel, Birmingham, 7.30 p.m.

June 29.—MANCHESTER AND DISTRICT I.G.E.: Chairman's Day, Town Hall, Pontefract. Luncheon 12.30 for 1.0 p.m., followed by visit to the Hemsworth Coke Ovens.

July 3-6.—BRITISH WOOD PRESERVING ASSOCIATION: Annual Convention, Cambridge.

July 6.—MIDLAND I.G.E.: Summer Meeting and Ladies' Day, Leicester.

July 9-14.—SOCIETY OF CHEMICAL INDUSTRY: 75th Annual Meeting, London.

July 16.—EASTERN G.C.C. 2 p.m.

Gas Prices Up in South West

GAS prices are to be increased from July 30, the South Western Gas Board announced on June 12. The extent of the rise was not mentioned.

The Board said they had hoped to hold the price of gas at its present level throughout the current year, but because of the recent increases in the cost of coal, labour, freight, and materials, which would add about £1,000,000 to its outgoings during the present financial year, an increase in the gas tariffs was inevitable. The Board also said that it expected to absorb a substantial portion of its increased costs by further improvements in the efficiency of its operations.

The last time there was an increase in the South-West was June, 1955, but before that the price had remained unchanged since June, 1952. During that three-year period benefits arising from the Board's integration of production, distribution, and administration, amounting to an equivalent of 2d. per therm, were passed on to consumers. Thus the price of gas remained constant in spite of continual rises in the price of coal, and other raw materials and wages.

SCOTTISH BOWLS AT GLASGOW

THE annual bowling match between the Scottish Gas Board, Glasgow Division, and the Scottish Association of Gas Managers' Bowling Club took place at the Welfare Club Green, Glasgow, on June 9.

Mr. T. Armour, President of the Glasgow Division Bowling Club, expressed a welcome to the visitors, and after the game he announced that Glasgow Club had been successful in winning the match with 34 shots up.

The Honorary President of the Glasgow Division Welfare Club, Mr. D. F. Young, said that he had much pleasure in seconding Mr. Armour's welcome to the Scottish Association of Gas Managers' Bowling Club, and he hoped that they were not disheartened by the result of the match. One day, he said, it was likely that he would be dropped from the Glasgow team and then they might have an opportunity to win!

Mr. W. T. Gilchrist, Cowdenbeath, on behalf of the Scottish Association of Gas Managers' Bowling Club, replied and thanked the hosts for a most enjoyable afternoon and the hospitality provided.

Points from the N.A.L.G.O. Conference

Redundancy: A Call for Co-operation

BUT NEW TECHNIQUES WELCOMED

STAFF redundancy was high on the agenda at the annual conference of the National and Local Government Officers' Association, in Edinburgh, earlier this month.

A report of the address given by Mr. G. W. Phillips, the Association's Organizing Officer for gas staffs, was given in last week's 'JOURNAL.'

On the general floor of the conference, the problem of staff redundancy was linked with a motion about automation, but it was made clear that redundancy may arise for reasons other than technical changes.

On the commercial side of the gas industry, for example, the credit restriction policy had led to a reduction of work and there were similar effects at Glasgow and elsewhere as a result of investigations by efficiency consultants.

Mr. T. Fernley (Manchester gas branch) said that he had come to the conference knowing that notices of dismissal were hanging over the heads of some of the Manchester members.

The staff wanted to help the Board to achieve efficiency; they believed in economy, but if the Board wanted these things done properly they must work in consultation with the staff. This the North Western Board had been slow to do. Redundancy could be met by normal wastage, slowing down recruitment, earlier retirement, and other devices which could be evolved jointly by management and staff, but the process of co-operation ought to begin long before the time when the problem would become acute.

The conference adopted motions calling for a detailed report on the probable effects of automation and expressing a four-fold policy towards technical improvements; first, welcoming the introduction of new techniques; secondly, seeking for the staff continuity of employment without loss of salary or grading; thirdly, as a long-term policy asking that the benefits of these techniques might accrue in the form of shorter hours, better holidays, and improved retirement arrangements; and fourthly, proposing that there should be adequate joint negotiation over the application of changed methods.

Collective Salaries

A collective salaries policy for all services covered by N.A.L.G.O. was laid down in a comprehensive motion proposed by the national executive council and carried with some minor amendments.

Mr. G. R. Ashton, speaking to the motion, outlined recent events in the salaries field and indicated the probable way ahead. The Association, although in fields where it was appropriate it adhered to the view that salary values agreed in 1946 ought to be restored, was no longer tied to so rigid a formula. If the motion was carried, the negotiators would continue to seek standards providing an adequately remunerated and attractive career in all services; but in so doing they would have regard to 'all relevant factors,' not only 1946 standards but also the trend in the cost of living, the movement of the wages index, and levels of pay in comparable employment.

In the gas industry, for example, it was not practicable to table an immediate claim because during the negotiation of the last, which was only just complete, they had used the argument provided by the improvements in the civil service and the service of the London County Council.

Gas Representation

The desirability of strengthening the representation of gas members on the governing bodies of the Association was urged in a motion proposed by Mr. W. Brain (Walsall gas branch). The motion asked that, as the present method of election had not produced representation on the national executive council proportional to the service interest, the reason for this might be examined and a remedy sought.

Mr. Brain said that the gas industry was passing through an era of revolutionary change and it was important that gas members should be directly represented on the council.

Mr. R. B. Biddle (Walsall gas branch), seconding, congratulated Mr. T. Fernley (Manchester gas branch) who had this year been elected to the executive council.

Mr. C. R. Gibson, a forceful representative of the electricity interest, opposed the motion. He admitted that from some points of view they did not get for the nationalised services a fair crack of the whip from conference, but on the issue of representation on the executive the remedy was in the hands of gas and electricity members themselves. If they came forward and offered themselves they would have every opportunity of getting elected despite any local government caucus.

This year, in fact, they had succeeded in some areas and if in the south west (Mr. Gibson's area) they had not it was because no one had offered himself for election.

The conception of the national executive council should be the same as that of the conference: It should represent all sections of the Association. The service conditions machinery of the Association (*ad hoc* committees for each service dealing with pay rates and other conditions of employment) provided the opportunity for dealing with sectional interests; because this worked well in gas and electricity it was not necessary for them to clutter up the general agenda paper of the annual conference with matters of specialist concern. Conference accepted this view and declined to agree to the Walsall motion.

Public Relations

A vigorous debate on the Association's public relations work concentrated upon the methods of communication between leaders and rank and file. A proposal to abandon the Association's monthly journal was defeated on the ground that it provided the means of direct contact between the centre and the individual member. The general tone of the debate showed that members would welcome improved communications within the Association and that these could with advantage be couched in more vigorous and more readily comprehensible terms than are documents merely passing on, for instance, the contents of a Whitley Agreement. Although the phrase was not used, the members seemed to be asking for the popularization of public relations techniques.

Firm's £6 Mill. Expansion Plan

STEWARTS and Lloyds are to spend £6.25 mill. on their tube making plant at Corby, Northamptonshire, under a recently announced project. New coke ovens are to be built to supply gas and coke to the works.

The 50 new ovens will take part of the load from the existing plant. When they are completed in about four years, reconstruction will begin of 143 old ovens which have now been operating about 24 years.

The extra coke and gas produced then will be needed to keep pace with the greater blast furnace production rate, said a company spokesman.

Sponsored by the Chemical Plant Manufacturers' Association and the Council of British Manufacturers of Petroleum Equipment, the Chemical and Petroleum Engineering Exhibition occupied the ground floor and gallery of the National Hall, Olympia, in addition to the ground floor and gallery of the Grand Hall.

Rising Costs a Threat to Irish Gas

PRICE INCREASES PENDING

BOTH in Northern Ireland and in Eire the effect of rising costs continues to have a seriously depressing influence on gas undertakings.

In Northern Ireland a substantial increase in the price of gas in Coleraine and Portstewart was foreshadowed by Alderman D. J. Christie at a meeting of Coleraine Borough Council.

Recent increases in wages and the cost of coal, he said, would mean an additional burden of £4,000 for the Council's gas undertakings. This would mean a rise of 7d. per 1,000 cu.ft. 'I do not want to see it any more than anybody else,' he added, 'but we will have to meet it, otherwise we will have to close down as an unprofitable undertaking.'

The Mayor, Alderman S. J. Henry, said in his opinion the increase would be more than 7d. Apart from the increase in wages and the price of coal they had to wipe off the loss incurred during the past two years in running the undertaking.

Alderman Christie said he thought that very soon gas undertakings in Northern Ireland would have to look into the economics of their industry to find out if they were going to continue.

BANGOR ACCOUNTS

'Disappointing'

At Bangor (Co. Down) the annual meeting of the Borough Council heard Councillor David Ewart, in his review of the year before vacating the Mayoral chair, point out that the accounts of the gas undertaking were a disappointment, the loss being £1,628.

Councillor Ewart said the loss was attributable to the present uneconomic rate of 6s. 5d. net per 1,000 cu.ft. The ever-rising cost of wages, salaries, coal and loan charges, which collectively amounted to over £10,000 extra last year, made it difficult to budget accurately, and further increases were pending.

A proposed advance of 6s. per ton in the price of coal, together with an increase of 13s. per ton in July last year meant that an additional £17,000 per annum had to be found for coal alone.

It was to be hoped that the Committee set up by the Ministry of Fuel and Power to enquire into the distribution costs of coal would find a way to ease the unfair burden imposed on gas undertakings in Northern Ireland.

And finally the latest news from Northern Ireland is that the Portrush Gas Company Limited has increased the price of gas by 5d. per 1,000 cu.ft., 'due to the increased price of coal.'

EIRE

Coal Up 27s.

From Eire comes the information that the Alliance and Dublin Consumers Gas Company has received permission from Mr. William Norton, Minister for Industry and Commerce, to increase the price of gas by 4d. per therm.

The Company's application to the Prices Advisory Body on May 18 was for an increase of 5d. per therm, due principally to increases in the price of coal from Britain which has gone up by 27s. per ton.

Cork Gas Consumers Company has applied to the Prices Advisory Body for an increase of 5d. per therm in the price of their gas.

Mr. S. L. Doyle, Secretary of the Company, said the increase was necessitated owing to increased overhead charges. There was no question of any increased profit going to stock-holders, whose dividend was not only less than last year but less than it was 50 years ago. Notwithstanding that the output of gas had about trebled. All revenue beyond the small amount for dividend was applied ultimately in providing service.

The application was opposed by the Cork Workers' Council, the Cork Council of Irish Unions and the Cork branch of the Irish Housewives' Association.

GASWORKS CLEANER DIES FROM LEAK CAUSED BY SAFETY TEST

INTENSIVE investigation revealed a leak 40 ft. from a cubby-hole at Nechells gas works in which a 68 year-old Gas Board cleaner was found gassed, it was revealed at a recent Birmingham inquest.

The leak had been caused by safety tests carried out to see that the gas equipment was in working order, the jury was told.

'An amazing set of circumstances,' commented the Coroner, Mr. G. Billingham. 'One would have thought it almost impossible this leak would have caused the man's death.'

The jury returned a verdict of accidental death on Henry Faultless, of Milton Street, Aston, employed at the gas works.

The foreman of the fitting group, Mr. Christopher Underwood, of Gothic House, Lord Street, said that Faultless kept his cleaning equipment in a cubby-hole under the stairs. He was found on May 9 sitting on a trolley in the cubby-hole.

Home Office pathologist Dr. F. E. D. Griffiths said that Faultless had died from a high concentration of coal gas poisoning.

Mr. Francis Bengough, Engineer and Works Manager at the Windsor Street gasworks, described tests carried out in the cubby-hole. He said 0.01% of gas had been found in the room after it had been sealed up for three-quarters of an hour.

A test taken outside under the stairs showed a high concentration of gas—in excess of 0.07%. This showed there had been a gas leak from somewhere, which had got in through the ventilator into the cleaner's cubby, he added.

A thorough examination of gas mains throughout the works the same day revealed a leakage of gas from a siphon pot on the other side of the works roadway—about 12 yd. away. The siphon had 'blown' because of high pressure arising out of safety tests made on the same day.

'Although we were all walking about for hours that day, we didn't smell the leaking gas,' added Mr. Bengough. 'It was a windy day and most of the gas would have been blown away in the air. But some obviously got away through the ground, travelled underneath the roadway, and got into the building through this ventilator.'

Asked by the Coroner if it was likely to happen again, Mr. Bengough replied 'No. This main isn't there any longer. From experiments, we found we could do without it, and it was altered so that it won't happen again.'

The Coroner: It could happen with the other mains in the works?—Yes.

G.C.C. DISAGREE ON TARIFFS

A WARNING that hoteliers in the Southern Gas Board's area would 'change over to some other form of heating' if no special tariff was allowed was given at a meeting of the area's Gas Consultative Council on June 6.

The observation was made by Colonel G. P. Durham, of Portsmouth, during a discussion on a recommendation from the Eastern area committee which expressed the view that there should be no special tariff for hoteliers.

The recommendation was the outcome of talks with the Isle of Wight Hotels' Association concerning the price of gas. The area committee consider that larger consumers of gas in the Isle of Wight, particularly hoteliers, had a problem peculiar to the locality which should be taken into account in fixing the steps of a block tariff.

Mr. J. C. Rea, the Chairman, recalled that when the industry was nationalised a policy of block tariffs had been adopted. Whether a gas user was a hotelier, or a baker or fish-fryer was not the point, he said. What use a consumer made of the gas was not the thing that mattered. It was only the amount used which was considered.

'If we make a concession to the hoteliers, then the bakers and the fish-fryers can quite legitimately come and ask us to do the same,' he went on.

JOHN PALLISTER TROPHY

Miss Crowther, daughter of the Board's Chairman, distributes rock to the children at Redcar.

Crowd of 1,300 at N.G.B. Sports

TWO special trains and several motor coaches were needed to bring employees from West Hartlepool and other towns when the sixth annual sports meeting of the Tees-side Division of the Northern Gas Board took place on the Redcar Race Course early in June. Altogether 1,300 people attended.

Events were organized on a Unit basis, the 'John Pallister' trophy being won by the Middlesborough Unit.

Present were Mr. E. Crowther, C.B.E., Chairman of the Board, and Mrs. Crowther. Prizes were presented by Mrs. J. R. Bradshaw and Mr. Bradshaw, a member of the Board.

Also present were Mr. L. A. Garratt, Industrial Relations Officer, and Mrs. Garratt, Mr. M. Allon, Member of the Board, and Mrs. Allon, Mr. W. R. Garrett, Constructional Engineer, and Mrs. Garrett, Mr. A. S. Middleton, Commercial Officer, and Mrs. Middleton, Mr. and Mrs. A. R. Croft, Carlisle, and Mr. and Mrs. J. E. McManus, Blyth, and Mr. John W. Pallister, General Manager of the Tees-Side Division, and Mrs. Pallister.

Gaslight, Please

THE celebrated novelist, Sir Compton Mackenzie, and other residents of Drummond Place, Edinburgh, are up in arms about new concrete electric lamp standards which are going up in their Georgian-style square.

They claim the lamps are out of character with the setting of the square. 'Why can't they leave us with our gas lighting?' asks Sir Compton.

SOUTH WEST G.C.C.: PUBLICIZE FIRE GUARDS

ON the recommendation of the Weston-Taunton local committee the South Western Gas Consultative Council at a meeting on June 6 agreed to ask the Gas Board to give the fullest publicity to the need for guarding gas fires.

Mr. H. Morland, Glastonbury, said there were unguarded fires even on Gas Board premises. The Board would fit guards on private and other premises at a reasonable charge.

Mr. L. G. Northcroft, Cheltenham, said many more accidents occurred in homes than on the roads. As much publicity should be given to 'home safety' as to 'road safety.'

A Board member, Mr. W. J. Baker, said it was the law that all fires sold must now be fitted with a guard, but there were probably about 100,000 existing gas fires in the south-west without guards. All the Board could do was to draw consumers' attention to the fact that they would fit guards for 7s. 6d. to 10s. each. 'But often a consumer will take the guard off a new fire because he does not like the look of it,' claimed Mr. Baker.

News In Brief

Brimington (Derbyshire) Parish Council are taking up with the East Midlands Gas Board the matter of a white deposit on gas cookers which it is stated is left by the gas.

A Mass Presentation to 110 employees—each of whom had spent more than 25 years in the service of the South Western Gas Board—was made at Prince Rock, Plymouth, recently. Alderman H. E. Wright, a Board member, made the presentation, and he was introduced by Mr. J. W. Dean, Engineer and Manager of the Plymouth and Cornwall Division.

Two New Electrolux sales and service offices have now been established. Liverpool and North Wales district office at 66, Bold Street, Liverpool, is under District Manager Mr. G. P. Jones, and East Midland District office at 173, Loughborough Road, Leicester, is under District Manager Mr. J. P. L. Thomson.

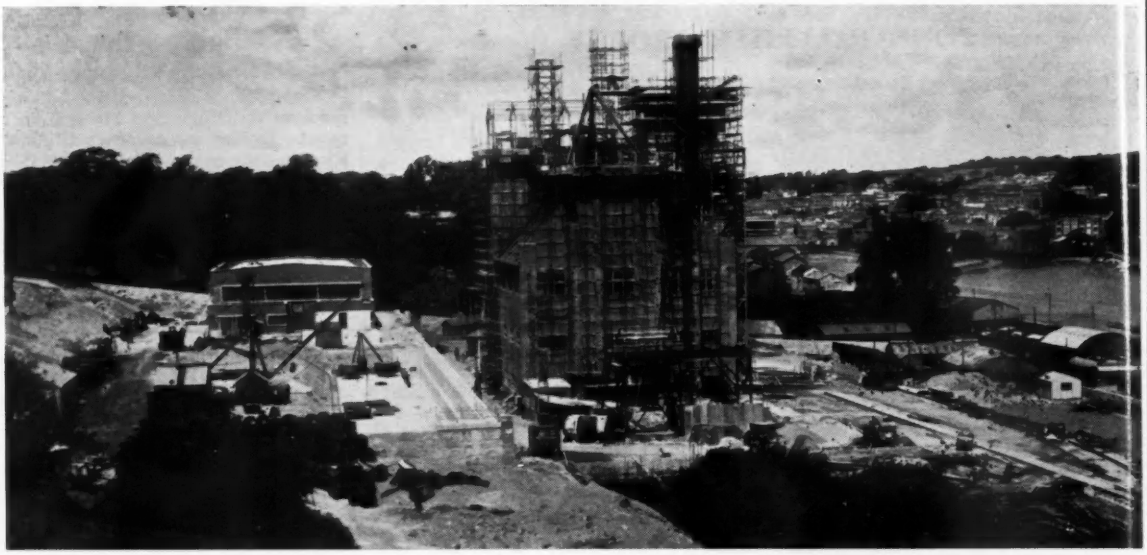
SCOTLAND'S 'IDEAL HOME'

'Scotland's Own "Ideal Home" Exhibition' is the title of a recent project sponsored in Edinburgh by Herbert Daniel Exhibitions, Ltd., at which the Gas Board were strongly represented.

The Gas Board exhibit occupied two stands, the larger of which was devoted to a general display of gas and coke appliances with two special sections, one dealing with home laundry aids and the other with gas-fired central heating.

The second stand was devoted mainly to cookery demonstrations.

The number of orders taken on the stand and the number of enquiries received were said to be 'very gratifying,' and confirm our view that although restrictions make the selling task very difficult, nevertheless increased promotional activity can help to preserve a good standard of sales achievement.



General view of site, showing the power house on the upper terrace with derrick cranes commencing erection of purifier boxes, also on the upper terrace.

New Works At Truro*

By

I. F. CARR, B. Sc., GRAD. I.C.E., ASSOC. M. INST. GAS E.

WHEN the decision was made to construct a new carbonizing plant in Truro, the extension of the old works was first considered. The space available for extension was, however, by no means extensive and the erection of a high modern carbonizing and coke screening plant, in such close proximity to the Truro Cathedral, was strongly opposed, on æsthetic grounds, by the local Council.

These facts necessitated the selection of a new site, outside the City precincts, and the Board, in conjunction with the county planning authority, selected a site at Lower Newham consisting of 13½ acres of land on the western side of the Truro river valley. The works is planned for the initial manufacture of 2 mill. cu.ft. of coal gas per day, with provision for future extension to 4 mill. cu.ft. per day when the useful working life of other works in the Group is finished and they are about to be closed down. There is sufficient space available for the future installation of further gasmaking plant of whatever type future policy may demand, in order that this works will be able to supply the gas requirements of the whole of Cornwall.

Intermittent vertical chambers have been chosen as the most suitable carbonizing plant, bearing in mind the coals which are to be used, and the retort house itself is very similar to the latest installation at Weston-super-Mare. A producer gas plant is being installed inside the retort house to provide the necessary diluent gas.

Use of Redundant Plant

Redundant plant from other works in the area has been used where possible to reduce the initial capital cost. The redundant plant used includes horizontal tube condenser, an electro detarrer, a wagon tippler, and two steam engines from Exeter, an exhauster and steam engine from Swindon, a small detarrer and solid fuel boiler from Newton Abbott, two purifier boxes previously ordered for Yeovil, a works meter from Plymouth, two tar pumps and motors from Stapleton Road, Bristol, two oil storage tanks from Truro old works, a road weighbridge from Brixham, and various large diameter pipe specials from most of the Divisions in the area. The use of these pieces of redundant plant, whilst saving considerably in initial capital cost, have caused some difficulty with regard to availability at the time required to suit our construction programme and also with regard to necessary overhaul.

Compressing Plant

The gasmaking capacity of the plant, even in the initial stage, is far greater than the requirements of Truro itself and in consequence compressing plant well in excess of that normally associated with a works of this size, is being installed for the necessary bulk supply pumping into the integration system, and provision is made for further compressing plant when the manufacturing plant is extended.

The eastern boundary of the works is within 50 yards of the bank of the Truro river and on this strip of land between the works and the river runs a road and a branch railway line to the Newham goods yard. The works is, therefore, well served with convenient modes of transportation. In the planning stage much consideration was given to the construction of a wharf in the river adjacent to the works for the unloading of coal from colliers by two grabbing cranes feeding into a hopper and from thence by a long conveyor over the railway line and road into the works. The two major objections to the scheme were:—

(*a*) The high initial capital cost of the wharf and the coal-handling equipment, and

(*b*) the reduced depth of the river, which made it unpracticable for colliers larger than 700 tons to navigate as far as Truro, and then only at certain high tides.

Nevertheless, this scheme was very competitive on a cost per ton basis with the alternative installation of a railway siding and wagon tippler, because of the low freight rates by sea. The final decision in favour of the railway sidings was made in view of the very much lower initial capital cost and the fact that the sidings could be used for the receipt and despatch of

* From a paper presented at Plymouth on May 19 to the Western Junior Gas Association.

other materials and goods besides coal. A further interesting feature of the works is the installation of diesel-driven alternators, running on heavy fuel oil, to generate all the electricity requirements of the works, and to be entirely independent of the public electricity supply.

Geography and Geology of the Site

The works site is situated on sloping ground which rises from approximately 10 ft. to 90 ft. above ordnance datum in about 500 ft., the general slope of the area of the site used for the initial development being about one in eight. According to the maps and publications of H.M. Geological Survey, the underlying country rock consists of highly fissile shales and sandstones of the Portscatho Series, probably of the Devonian Age. From the results of boreholes and trial pits it was found that these rocks underlie the site at depths varying from 4 ft. to over 20 ft.

On the southern margin of the site there is a disused quarry containing a medium grained acid intrusive dyke, locally known as elvan. The only remaining workable elvan face in the quarry was, however, retained by the vendor of the land in his remaining property. Above the bedrock on the hillside there is a thin layer of weathered shale which, in turn, is covered by a mixture of silt and clay which was derived from the bedrock by weathering. The area to the east of the site next to the road is covered with head deposits composed of an irregular accumulation of stony material which is somewhat stratified. On the surface, overlying the whole site is about 2 ft. depth of top soil with roots.

From the results of tests carried out by Soil Mechanics, Ltd., it was found that the natural ground, after removal of the top soil, could take a bearing pressure of ¾ ton per sq. ft. *in situ*, or, if soft patches were excavated and the material re-compacted in layers of 9 in. thickness, rolling each layer, a higher bearing pressure could then be used, say, up to 1½ tons per sq. ft. The shale bedrock can take a bearing pressure of up to three tons per sq. ft. with safety. The land immediately surrounding the quarry and the strip of land between the railway line and the Newham Road is wooded, and these trees should help to screen the works from view in that direction.

Because of the considerable slope of the land in the development area it was decided to form three level terraces, one above the other, with retaining walls between them, thus providing level sites for plant and buildings. An access road to all three terraces was sited along the northern boundary of the works running up at an average slope of one in nine from the works entrance on Newham Road to the highest terrace.

A separate access road was made at the southern end of the works to the gasholder site which is in the quarry. The positioning of the holder in the quarry saved much valuable space on the main development area and at the same time afforded reasonable camouflage for the holder itself, since the tank and outer lift is hidden by the walls of the quarry and the surrounding trees.

For descriptive purposes, it is convenient to consider each terrace separately, and reference should be made to Fig. 1, the work's layout.

Low Level Terrace—Level 15 ft. Outside Diameter.—On the low level terrace, the average width of which is 100 ft. and which is 460 ft. long, is situated the work's entrance from Newham Road, the road weighbridge, the office block, the coal stocking yard and the effluent filtration plant.

The office block contains the works engineer's and foreman's offices, the weighbridge office, laboratory, work's store, workshop, calorimeter room, ambulance room, messroom, washroom, lavatories and garage accommodation for work's vehicles. It is situated beside the access road and adjacent to the work's entrance, which is convenient for easy entrance and exit, without having to cross the works.

The coal stocking yard, with a maximum capacity of about 7,000 tons, occupies the majority of the ground area on the terrace. Coal is put into stock and also reclaimed by a grabbing crane, having a long jib, which operates from the middle terrace. It is planned to plant a screen of trees along the inside of the Newham Road boundary wall, to run the full length of the coal stocking yard.

The effluent filters, about which more will be said later, have been situated on this terrace to conform with the general pattern for the conveyance of liquids by gravity flow, where possible, to eliminate pumping. The filtered effluent and storm water then flows by gravity into the Truro river.

Middle Terrace—Level 31 ft. Outside Diameter.—On the middle terrace, which is 167 ft. wide and approximately 420 ft.

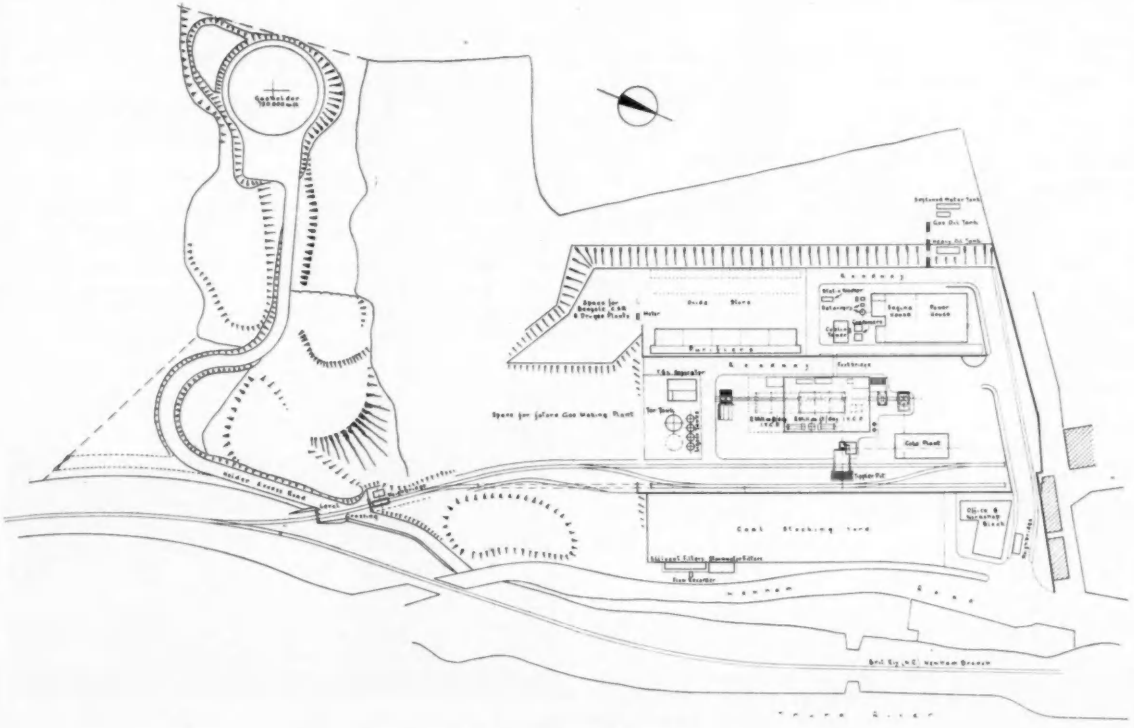


Fig. 1.—*Works Layout at Truro.*

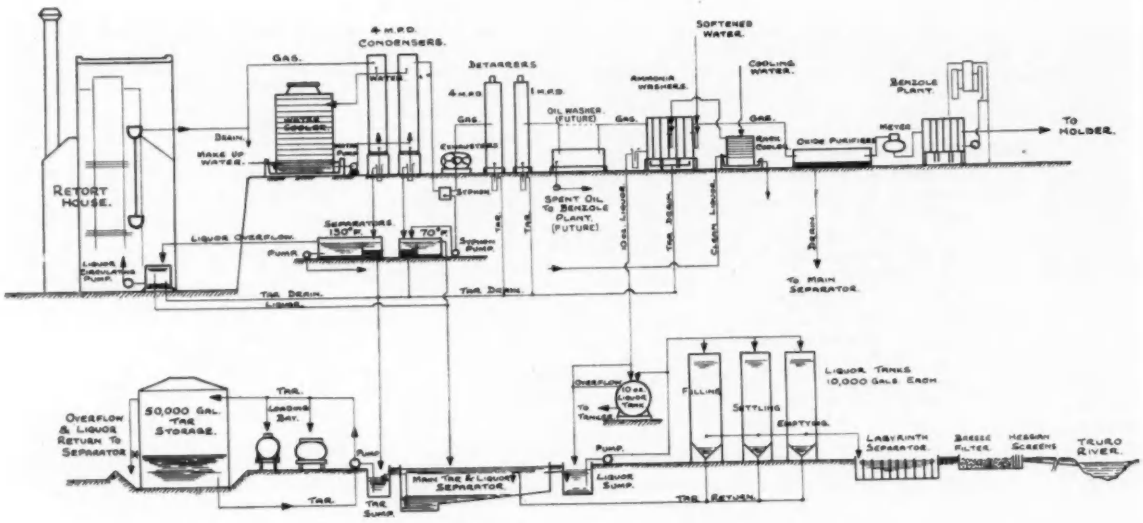


Fig. 2.—*Flow diagram for gas, water, tar and liquor.*

long, is situated the retort house and coke storage and screening plant, railway sidings, wagon tippler and tar and liquor tanks.

The retort house is situated fairly centrally on the terrace with a roadway between it and the rear or upper retaining wall, and the railway sidings running between the house and the front or lower retaining wall. Space is left at the southern end of the house for future extension.

The sidings drop some 3 ft. or 4 ft. from the level of the British Railways' branch line to the weighbridge and then run dead level along the front of the terrace. The rails are set in concrete with the top of the rail flush with the concrete surface so that road vehicles are not obstructed in this area.

Land Reserved

The coke storage and screening plant is situated at the northern end of the terrace and is adjacent to the railway sidings. Provision is made for two chutes from each hopper to load either into railway wagons on one side or road vehicles on the other. Sufficient yard space is available by the coke plant for the storage of about 500 tons of coke. The main tar and liquor separator, the tar storage tank, liquor settling tanks and the 10 oz. liquor storage tank, are to be situated at the southern end of the terrace. The land further to the south of the terrace and not, at present, to be developed, is reserved for future gas manufacturing plant.

High Level Terrace—Level 50 ft. Outside Diameter.—On the high level terrace, which is 110 ft. wide and approximately 500 ft. long, is situated the power house and engine house block, the cooling tower, condensers, electro-detarrers, washing plant, purifiers and the station meter. Particular care was taken in the siting of the ancillary plant to ensure that further plant could easily be installed to increase the capacity of the works from 2 mill. cu.ft. per day to 4 mill. cu.ft. per day.

The power house and engine house block is situated at the northern end of the terrace for easy access and also to obtain a good foundation afforded by the bedrock which is near to the surface in this area. On the high ground to the west of the terrace and adjacent to the power house are sited a heavy oil and a gas oil storage tank and a softened water storage tank.

In the area immediately to the south of the engine house is grouped the ancillary plant and the annexes to the engine house on the south side contain the water softening plant, detarrer electrical gear and an office for the power house and engine house attendant. The purifiers, which are sunk into the ground, are situated in line behind the retaining wall, and the station meter is placed at the end of the purifiers. Space has been left at the southern end of the terrace for the future installation of a benzole plant, a catalytic sulphur removal plant and a dri-gas plant.

Prior to the construction of buildings and the erection of plant, contracts were let for the necessary earthworks and retaining walls to form the terraces and for the access road and stormwater drainage.

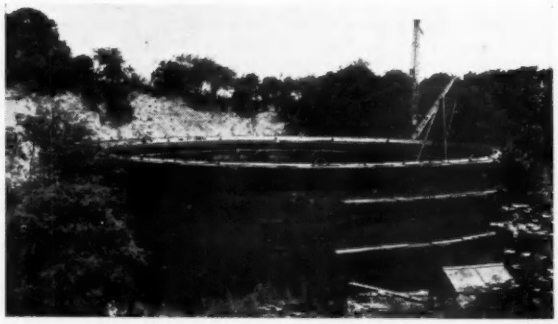
The first task was to remove the top 2 ft. of surface soil, consisting of some 14,000 cu. yards, since this was unsuitable material upon which to erect buildings, construct roads and lay down hard standings. This soil was pushed into mounds with bulldozers and then loaded into lorries by a bucket excavator and carted three-quarters of a mile from the site and used to spread over the Truro City Council's refuse dump, thus reclaiming waste ground.

Retaining Walls

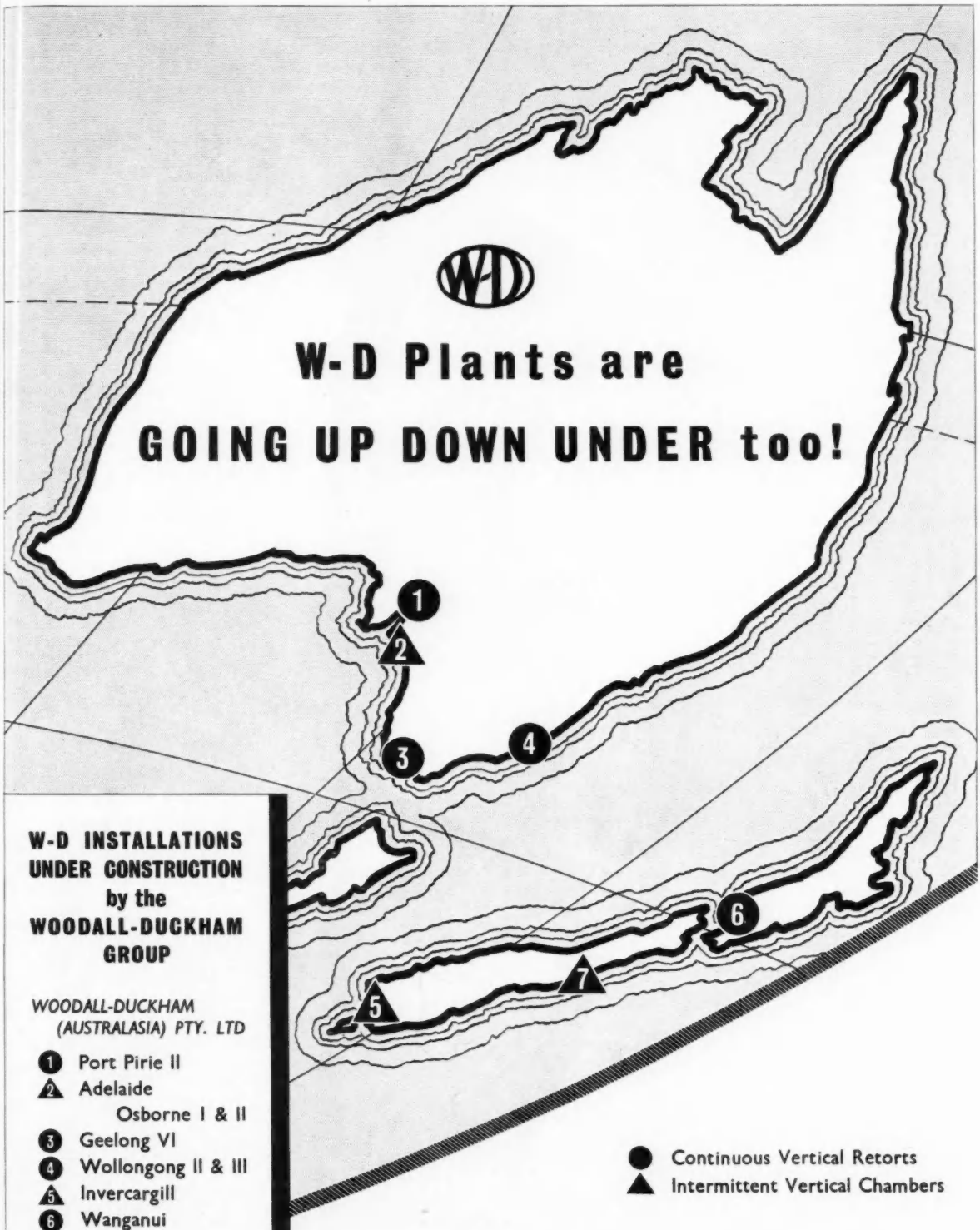
The second task was to build the retaining walls to form the three terraces and a general specification for this work was prepared for tendering. It was with some surprise that it was found that granite block retaining walls, as offered by the local contractor, was the cheapest tender. These walls have a far more pleasing appearance than concrete, and are, of course, much more durable. The walls were constructed on a mass concrete foundation and the blocks of granite, some weighing over a ton each, were swung into position with a mobile crane and bedded in concrete. The base of the largest retaining wall is 7 ft. thickness of granite.

Provision was made in the main retaining walls for the laying of drains and services through them by constructing a tunnel, approximately 3 ft. wide by 2 ft. high, through the base of the wall and building a manhole on the high side through which these service pipes can be laid at a future date.

Following on from the retaining wall construction was the levelling off of the areas between the walls. This was carried out by excavating the high side, which, in each case was the



The all-welded gasholder, under construction in the quarry. The derrick used in its erection can be seen on the right of the photograph.



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western side of the terrace and using the material thus excavated to fill the low side. The filling was carefully controlled to ensure a high density by spreading in 9 in. thick layers and then rolling with a steel wheeled roller for a minimum of ten passes before spreading the next layer.

The excavators on the western side of the terraces were in some cases partly in rock since, at these points, the excavations were taken out to a depth considerably below the original ground level. This was particularly the case on the middle terrace and for the access road at the northern end of the site. Compressor-driven pneumatic tools were used to break up the rock, which was then pushed away with a bulldozer.

A nominal crossfall was formed on each terrace, from west to east, so that rain water would not 'pond' on the terrace before the drainage system was completed, but tend to run down the site to the existing drains in the Newham road. After completion of the terrace levelling, the storm-water drainage system was laid. This system conforms generally to the three terrace layout. Rainwater trap gulleys on the high level terrace are drained via intermediate manholes to a common manhole adjacent to the tunnel through the retaining wall. The water is passed via a cast iron pipe laid in the tunnel, through the retaining wall and into the middle terrace drainage system. A similar arrangement is provided between the middle and the low level terrace. On the low level terrace the rainwater is passed through a settling bay followed by coke and hessian screen filters before discharging into the Truro river. This filtration is carried out to ensure that no impurities picked up by the rain water in the form of oxide, tar globules, breeze, oil, *etc.*, are allowed to escape and pollute the river.

Carbonizing and Coal and Coke Handling Plant

The carbonizing plant is a Woodall-Duckham intermittent vertical chamber installation comprising one bench of 18 nominal 3¾-ton chambers arranged in three settings, each of which contain six chambers, recuperators and one step-grate producer. A throughput of 8⅓ tons per chamber per day is envisaged, making a total of 150 tons per day for the bench of 18 chambers. Provision is made at the south end of the bench to facilitate the future installation of three further settings each of six chambers, thus making a complete bench of 36 chambers.

A producer gas dilution plant, including a gas washer, is situated in the retort house and is capable of producing sufficient gas to reduce the calorific value of the coal gas made by the final plant of 36 chambers from 550 to 475 B.Th.U. per cu.ft.

The coal handling plant is designed to handle 40 tons per hour and the coke handling plant to handle 25 tons per hour. The general scheme is that coal is delivered in rail wagons on to the sidings and the wagons are tipped by a 'liftaside' wagon tippler, capable of handling 23½ ton wagons, discharging the coal into a ground level coal receiving hopper. Provision is made to facilitate the tipping of coal into this hopper from road vehicles.

The coal is then fed via a 'Locker-Traylor' vibrating feeder from the bottom of the coal receiving hopper to the boot of a bucket elevator arranged within the hopper pit. It is then raised by the bucket elevator and delivered on to belt conveyors above the coal storage hoppers for distribution throughout the hoppers, which have a capacity equivalent to 60 hours requirements of the initial bench. From the bottom of the overhead coal storage hoppers the coal is discharged into an electrically-propelled chamber charging car, operating above the bench, by means of which the coal is charged into the chambers.

A producer fuel hopper of 30 hours capacity and a chamber pad coke hopper of 60 hours capacity are also provided as an extension of the coal storage hopper in the north end bay of the house, and both the coal and coke hoppers, together with all internal bracings, are lined throughout with cement, 2 in. thick, applied by the 'Gunite' process.

The chamber charging car is provided with a separate compartment for pad coke and the coke for the producers and for the dilution producers coke feed hopper is delivered by a hand-propelled producer charging skip operating on an overhead monorail above the producers. The bottom doors of the chambers are operated by hydraulic pressure supplied by means of a hydraulic accumulator and pump.

On completion of carbonization the hot coke is discharged into a hot coke skip arranged to travel on rails laid in the floor beneath the setting. When loaded, the skip is hauled by means of electrically-operated chain haulage gear into a quenching tower at the north end of the house. On completion of the quenching operation the skip is hauled outside the quenching tower and discharged into a ground level coke receiving hopper. From this hopper the coke is raised by skip hoist into the buffer hopper arranged at the top of the coke storage and screening plant structure.

Should the skip hoist have a breakdown, provision is made for getting the hot coke skip out of the house at the end opposite to the skip hoist, the coke being tipped in a pile on the ground outside the house.

The coke hoppers in the retort house are supplied by means of an overhead band conveyor running back from the buffer hopper at the top of the coke storage and screening plant.

The procedure for stocking coal is to employ a mobile grabbing crane with a long jib, situated on the middle terrace, to grab coal from railway wagons standing on the sidings and deliver the coal on to the stock pile below. To reclaim from stock the crane grabs from the stock pile and delivers either directly into the coal receiving hopper, or, if not within reach of the hopper, into an empty wagon, which is tipped in the usual way. Provision has been made for the future installation of a belt conveyor to run from a future ground level hopper on the low level terrace, feeding into the boot of the bucket elevator arranged in the existing coal receiving hopper pit. Coal reclaiming will then be effected by bulldozing coal into this new hopper on the low level terrace.

Two waste heat boilers are situated at floor level in the east side bay of the retort house, one boiler working in conjunction with the proposed initial bench and the other acting as a standby.

The layout of the boiler plant provides for the future installation of a third boiler in an annexe to the east side of the house when the future bench is installed, so that each boiler shall work on the waste gases from 18 chambers and the third act as a common standby. Each boiler is 6 ft. 6 in. diameter with a length of 15 ft. between the tube plates, constructed for a working pressure of 130 lb. per sq. in.

The foundations of the bench and retort house have been carried down to the shale bedrock, the building being so situated that only the eastern side house foundations required to be increased in depth by approximately 4 ft., in the form of concrete piers, to obtain a bearing on the rock.

The bricks used in the construction of the house were the London Brick Company's 3 in. (nominal) sand-faced bricks, which were accepted by the Town & Country Planning Committee as being quite suitable from the æsthetic viewpoint.

There is a footbridge between the high level terrace and a door in the west wall of the retort house, allowing a headroom of 19 ft. on the roadway below, to give both easy pedestrian access and a suitable supporting structure for electrical cables and cooling water pipelines running between the retort house and the power house and cooling tower.

Coke Storage and Screening Plant

The coke storage and screening plant has been designed and constructed by The Woodall-Duckham Construction Company. It is to handle 25 tons of coke per hour and to screen it into the following grades: over 1¾ in., 1¼ in. to 1¾ in., ½ in. to 1¼ in. and under ½in. The storage capacity of the bunker is 400 tons of all grades of coke.

The general scheme is that coke from the buffer hopper at the top of the structure is passed on to a vibrating primary screen separating it into breeze (under ½ in. size), middle-cut and over 1¾ in. size. The breeze is then delivered into the corresponding compartment in the bunker beneath. The large coke and middle-cut is discharged from the primary screen into a bifurcated chute and passes either on to the belt conveyor for supplying the retort house coke requirements, or on to a grading screen of Cort's manufacture. The grading screen separates the coke into the grades as mentioned above and it is then delivered into corresponding compartments in the bunker. A spiral chute is provided in the over 1¾ in. size compartment in order to reduce breakage of coke to a minimum.

The sloping bottoms of the bunker compartments are lined with 1½ in. thick blue brick spits, set in cement mortar.

Two travelling debreezing screens of Pegson's manufacture are arranged beneath the bunker to serve the chutes to road

vehicles on the west side of the bunker. A leg from each bunker chute, fitted with a hand-operated flap door, feeds coke to two portable coke weighing and bagging machines, of the Belle Isle type, situated on the bagging platform beneath the bunker.

Provision is made for the chutes to be fitted on the east side of the bunker to deliver into railway wagons as may be required in the future. The structure itself is made entirely of reinforced concrete and the foundations are carried down some 15 ft. below ground level to the shale bedrock. It is of orthodox design, using mild steel reinforcement and ordinary Portland cement.

The attention paid to exact alignment of the form-work and the careful vibrating of the concrete while placing, has resulted in a first class finish being obtained, without having to resort to extensive rubbing down of exposed concrete faces. The water : cement ratio of the concrete mix was kept as low as possible consistent with reasonable workability, and the regular crushing tests of 6 in. cubes, carried out during construction, have proved the soundness of this procedure, with crushing stresses between 3,000 and 4,000 lb. per sq. in. being obtained at seven days with a nominal mix of one part cement, two parts of fine aggregate and four parts of coarse aggregate, all proportioned by weight.

Gas Ancillary Plant

The gas ancillary plant is all situated on the high level terrace and the vessels are arranged on mass concrete foundations which, in cases where the load per unit area is high, have been carried down to bedrock.

Condensers.—The plant consists of two Holmes horizontal tube condensers (ex Exeter), which have been retubed and generally overhauled. The condensers are arranged in series and are capable of cooling 4 mill. cu.ft. of gas per day from 176°F. down to 70°F. under normal atmospheric conditions when passing 16,500 gal. of cooling water per hour.

In the initial stages, when only 2 mill. cu.ft. of gas per day is being manufactured, the condensers will only pass 9,700 gal. of water per hour to obtain the same temperature drop in the gas.

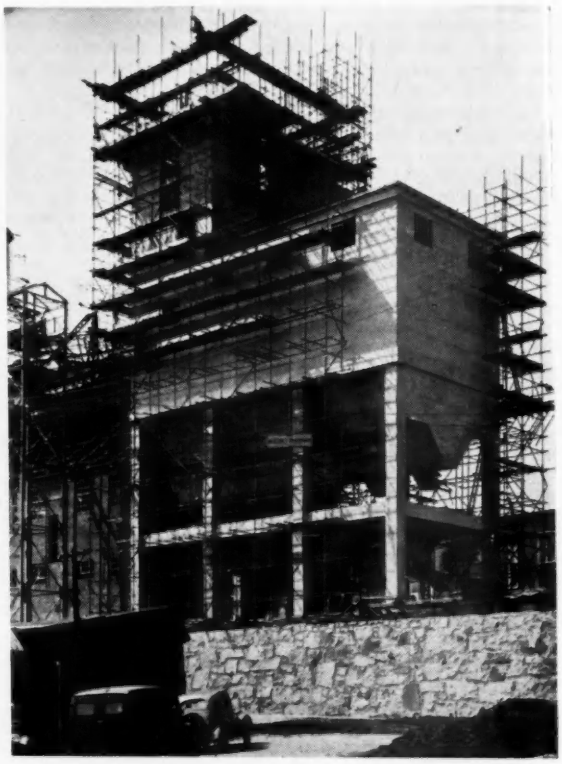
Adjacent to the condensers is arranged a cast iron tar and liquor separator which is divided into two compartments. Into the first compartment is drained the tar and liquor from the first condenser in the gas stream, at a temperature of approximately 130°F. and the hot liquor so separated overflows and is passed in a gravity feed pipeline to the tar and liquor separator in the retort house. A second connection is made to this compartment of the condenser separator for liquor which is pumped, via a rack cooler, to the ammonia washer for use in its first compartment in the gas stream.

Exhauster.—Two Holmes Connersville exhausters (one ex Swindon and one new machine) are situated in the south end of the engine house. The second-hand exhauster is driven by a Sisson steam engine (also ex Swindon) supplied with high pressure steam from the waste heat boilers and the new exhauster is driven by an electric motor. Each exhauster is capable of passing 2 mill. cu.ft. of gas per day and initially one machine acts as a standby for the other. Provision has been made in the engine house for the future installation of a third exhauster of a similar size, when the works is extended, so that one machine will then be a standby to the other two.

Electrostatic Detarrers.—Two electrostatic detarrers are arranged adjacent to the engine house annexe which contains the electrical gear associated with them.

Both detarrers are of Whessoe's manufacture, the first (ex Exeter) is capable of passing a nominal 4 mill. cu.ft. of gas per day, and the second (ex Newton Abbott) is capable of passing 1 mill. cu.ft. of gas per day. Because of the high overload factor of the plant it is proposed to use this smaller detarrer as a standby initially, but when the works is extended to 4 mill. cu.ft. of gas per day, it will be replaced by a larger unit.

Ammonia Washer.—The ammonia washer is a new Holmes multifilm static washer, capable of passing 2 mill. cu.ft. of gas per day and producing 35 gal. of 10 oz. strength liquor per hour. This liquor is drained from the washer by gravity into a 10 oz. liquor storage tank of mild steel welded construction and a capacity of 10,000 gal., situated on the middle terrace. It is proposed to develop a local market for the sale of this liquor for agricultural purposes and provision is made for the filling of road tankers from this storage tank. Provision has also been made on the high level terrace for the installation of a further identical washer, when the works is extended.



General view of the coke bunkers from the lower terrace.

Purifiers.—The purifiers, capable of passing 2 mill. cu.ft. of gas per day, consist of five cast iron oxide boxes, each 20 ft. by 35 ft. by 6 ft. deep of C. & W. Walker's manufacture, arranged in line behind the high level terrace retaining wall, and with the body of the boxes sunk into the ground so that the top is approximately 6 in. above the surrounding ground level. A travelling crane gantry will run on rails along the length of the boxes for removal of the covers.

It is anticipated that by arranging the boxes below ground level no serious problem will arise with regard to temperature control of boxes in cold weather. It is proposed to use the grabbing crane used primarily for coal stocking to assist in the emptying of the boxes after the oxide has been broken up by hand.

Station Meter.—One 12 in. by 36 in. Holmes Connersville meter (ex Plymouth) is situated at the end of the purifiers, which in the interests of economy it is not proposed to house in a building. The redundant pipe connections and valves have also been incorporated and it is proposed to install a similar meter adjacent to it for metering the gas from the future set of identical purifiers independently.

Gas Mains.—From the retort house the 24 in. diameter steel foul main to the condensers is carried on welded steel tubular pipe supports at approximately 14 ft. above the high level terrace. A 6 in. diameter high pressure and a 4 in. low pressure steam main are carried on hangers below the foul main which run between the retort house and the power house. The 24 in. diameter outlet main from the condensers enters the engine house below ground level for inlet to the exhausters. This section of the main is in cast iron and a Horsley syphon is included in this length.

The outlet main from the exhausters is a 24 in. diameter steel main, carried on tubular steel pipe supports and connects to the two detarrers and from thence to the ammonia washer before reducing the 18 in. diameter and entering the purifiers

in a section of underground cast iron pipe. A safety seal vessel is incorporated on the main between the detarrers and the static washer arranged to 'blow' at a pressure of 42 in. W.G.

From the outlet of the purifiers a cast iron underground main runs to the station meter and from thence to the gasholder in the quarry. An outlet main from the gasholder is also cast iron and is connected to the low pressure main to Truro town and to the inlet of the compressors in the engine house.

All the sections of cast iron main between the retort house and purifiers have run lead joints and after the purifiers, have flexible mechanical joints. All the steel mains up to the inlet of the ammonia washer have been stress relieved and provision has been made in the design of the mains for branch connections in order to facilitate the easy incorporation of future plant.

The Utilization of Waste Heat Steam

Under normal working conditions the sole source of steam will be from one waste heat boiler, producing 3,800 lb. of steam per hour at a pressure of 120 lb. per sq. in. and a temperature of 500°F. working off 18 chambers. A solid fuel vertical tube Cochran boiler is, however, installed in an asbestos sheeted shelter at the south end of the retort house extension area. It is capable of producing 2,480 lb. of steam per hour at a pressure of 130 lb. per sq. in. and it will be used on the initial starting up period and thereafter as a standby to the waste heat boilers. After making due allowance for the steam usage of the boiler feed pumps, feed heater and condensate losses in the main, 3,400 lb. of steam per hour at a pressure of 110 lb. per sq. in. and a temperature of 400°F. is made available in the power house to drive two Sisson steam engines (both ex Exeter), which in turn drive two 80 kW. induction generators as indicated diagrammatically on Fig. 4.

One steam engine has been modified to exhaust steam at atmospheric pressure, the steam being condensed and returned via a condensate de-oiling plant to the boiler feed. The other engine is to work at an exhaust back pressure of up to 20 lb. per sq. in. in order to provide the required retort house and work's process steam. If the process steam demand falls, the amount of steam supplied to the back pressure engine is reduced and this steam is used by the condensing engine, thus giving a greater total electrical power output. It should be noted that the requirements of the steam driven exhauster has not been taken into the considerations of H.P. steam consumption, as it will only be used intermittently at this stage, as a standby to the motor driven machine.

Power Generating Plant

Apart from the electrical power provided by the steam driven induction generators, the bulk of the electricity requirement of the works is generated by a diesel driven alternator set, running on heavy fuel oil. Since there is no connection with the public electricity supply, two identical diesel alternator sets are installed, each one being capable of supplying the total electricity requirements of the works.

Ancillary equipment for these two sets, being automatic air starting equipment, oil-heating, centrifuging and clarifying equipment, pumps and heated pipelines are installed inside the power house and a gallery at the northern end of the building, approx. 14 ft. above floor level, carries two 500 gal. capacity daily service tanks for heavy oil, which are fitted with heating coils and one 500 gal. capacity daily service tank for gas oil.

It is proposed to run the engines on heavy fuel oil having a viscosity of 950 secs. Redwood No. 1 at 100°F. but for an experimental period medium fuel oil, having a viscosity of 200 secs. Redwood No. 1 at 100°F. will be used until experience has been obtained in the maintenance of the engines and in the operation of the oil purification equipment.

A heavy oil storage tank of approx. 11,000 gal. capacity, and fitted with a steam heating coil at the oil draw off point, is situated on the bank at the west side of the terrace. From this tank the lagged oil line to the daily service tanks is heated by means of a steam 'tracer' which is bound to the oil line with the lagging. A gas oil storage tank of approximately 3,500 gal. capacity is situated above the heavy oil tank on the same bank and is connected by unheated line to the gas oil daily service tank in the power house.

Also situated in the power house is the main 415 v. switchboard of George Ellison's manufacture which incorporates 11 panels for the operation of the two 200 H.P. compressors, two 285 kW. diesel alternators, two 80 kW. induction generators and the ancillary plant and retort house feeders. The necessary distribution and sub-distribution panels are supplied by Lancashire Dynamo & Crypto Ltd.

Compressors

The compressing plant consists of two electrically driven compressors, each capable of compressing 100,000 cu.ft. per hour against a pressure difference of 30 lb. per sq. in. Initially one set will act as a standby to the other, but provision has been made in the foundation block for the future installation of a diesel driven 200,000 cu.ft. per hour compressor, when the send-out is increased, in which case the two 100,000 cu.ft. per hour sets will act as standby to the larger one and also deal with lesser gas demands. Each set comprises of one vertical two crank reciprocating compressor of Bryan Donkin's manufacture, absorbing 182 B.H.P. and running at a speed of 485 R.P.M. directly coupled to a Lancashire Crypto slip ring induction motor developing 200 B.H.P. at 485 R.P.M. on a 415 v., 3 phase, 50 cycles supply. Each set is fitted with automatic unloading equipment to each cylinder as well as hand unloading gear.

When the works commences gasmaking the amount of gas to be compressed will be less than 100,000 cu.ft. per hour and consideration was given to the fitting of sleeves and smaller pistons in the cylinders of one compressor, to deal with this lesser load. It was found, however, that in this case the reducing of volumetric displacement would lead to little, if any, horsepower saving with the 200 H.P. constant speed drives, and the cost and inconvenience involved in the initial sleeving and final restoration of capacity have ruled out this proposal and volumetric control will be effected on each compressor by use of the unloading gear.

Engine and Power House Building

The engine and power house building constructed by A. Monk and Co., Ltd., is a steel-framed structure, 100 ft. long by 60 ft. wide, with 9 in. brickwork walls, using the same bricks as in the retort house, and having a steel truss roof, spanning across the full width of the building.

The roof covering is asbestos reinforced troughing clipped to I-beam purlins running across the trusses. Lifting beams, arranged over the centre line of each machine, are attached to the underside of the roof trusses.

The provision of standard patent glazing windows high up in the north, south and west walls of the building allow useful wall space up to 15 ft. above ground level, uninterrupted by windows, for the positioning of auxiliary equipment and pipelines against the walls. The provision of precast concrete mullions to the windows, and concrete jambs and lintels to the doors, greatly enhance the external elevations of the building. Cable ducts with chequer plate covers have been provided for all 415 v cabling running to and from electrical machinery.

Precautions have been taken with regard to vibrations caused by the machinery by grouping a number of machines on one large common foundation block and completely isolating the block with a 2 in. thick layer of vibration insulating material known as coresil, the basic raw material of which is cork. The design envisages the absorption of the vibration by the large mass of the foundation block, to which the machinery is rigidly fixed, and the minute vibrations of the block itself, insulated by the coresil. Care was taken to ensure that the coresil remained dry by asphalte tanking of the outside of the reinforced concrete tank in which the coresil and foundation block were situated. A gas-tight partition wall, with observation windows, divides the engine house from the power house and the electric motor driving shafts for the compressors pass through this partition wall, the motors being situated in the power house. The only prime movers in the engine house are the steam engine driving one exhauster and the electric motor, which is totally enclosed and flameproofed, for the other exhauster.

It was considered necessary for an attendant to be present 24 hours a day in this building, since the electricity generation is an independent system and the compressors will eventually be passing all the gas supplied to Cornwall, excluding Truro itself, and are therefore vital installations for maintaining the continuity of gas supply. In consequence of this decision, an

attendant's office, messroom and lavatory are provided as an annexe at the south-east corner of the building. An observation window in the wall of the office and the engine house allows the attendant to view the machinery when seated at his desk.

Water Supply and Cooling Tower

The basic water supply will be provided by the Truro Water Company, but water from an existing spring on land approximately half a mile from the works, which at the present time flows by gravity pipeline to the old Truro gasworks, is to be pumped to a storage tank on the new works. During the winter this spring will provide as much as 20,000 gal. per day, but in the height of summer this yield is considerably reduced.

Consideration was given in the early stages to the use of the Truro river water for cooling purposes. Samples were taken and it was found that at low tide the water was 99.5% fresh but that at high tide it was 83% sea water. During the summer months the amount of water flowing at low tide was small and had been known to dry up completely in times of severe drought. The difficulty of constructing a suitable intake and pumping station on the mud flats and the fact that we are not riparian owners culminated in the decision not to use this possible source of supply.

The initial water requirement of the works is approximately 36,000 gal. per day, of which approximately 8,500 gal. per day is softened for boiler feed, tie rod cooling and ammonia washer water, and the remaining 27,500 gal. per day is supplied to the cooling tower pond.

The cooling tower is of the induced draught type constructed of timber and arranged on a reinforced concrete base which forms at a collecting pond. The tower is of Davenport Engineering Company's manufacture and is capable of cooling 25,200 gal. per hour from 107°F. to 70°F. when the prevailing wet bulb temperature is 60°F.

The details of the water cooling requirements of the plant are as follows:—

	Gal. per hour.	
Gas cooling	9,700	115°F.-70°F.
Tie rod water head exchanger Steam engine surface condenser	9,000	103°F.-70°F.
Gas compressors	1,500	80°F.-70°F.
Diesel alternators	5,000	85°F.-70°F.
Total	25,200	107°F.-70°F. Average

A water supply pipe is taken from the head of the gas condensers back to the retort house to supply the raw water requirements of producers, dilution producer washer and seal with a drain to the quenching water sump.

Fire hydrants are to be situated at salient points on the works which are connected directly to the town supply. Hydrant standpipes are to be supplied by the local fire service to ensure standardization of equipment. The towns water has a hardness of 6.1° (3.1° temporary and 3.0° permanent) and a Permutit base exchange unit is installed in an annexe at the south-west corner of the engine house capable of softening water at the rate of 700 gal. per hour and passing 34,000 gal. between regenerations of the softening bed.

In order to reclaim the condensate from the condensing steam engine and from other sources, a 'Neckar' condensate de-oiling plant is installed adjacent to the detarrers in the ancillary plant area, south of the engine house, capable of passing 300 gal. of condensate per hour.

Tar and Liquor

Tar and liquor is drained from the plant separators and seal pots either into the main separator, situated on the middle terrace, or directly into the tar or liquor sumps which are constructed integral with the main separator. From the main separator liquor overflows into the liquor sump and tar is syphoned off into the tar sump. From the tar sump the tar is pumped into the tar storage tank, and from the liquor sump the liquor is pumped into one of three settling tanks. The arrangement being for one liquor settling tank to be filling over 24 hours while the second tank, already full, is settling during this time and the third tank, having already settled, is emptying slowly by gravity. From the third liquor settling tank the liquor is drained by gravity to the effluent filtration tank on the low level terrace, and from thence via a flow recorder to the Truro river.

The conditions under which the weak liquor is discharged into the river are strictly controlled in accordance with the agreements made with the Cornwall River Board, whereby only perfectly clean liquor is discharged over a period of three hours immediately following each high tide, in order to obtain adequate dilution of the liquor in the large volume of water then present in the river.

Main Separator and Tar Liquor Sumps.—This installation consists of a reinforced concrete tank 35 ft. long by 27 ft. wide by 16 ft. deep (average), which is arranged with its working level some 4 ft. below the surrounding ground level to facilitate drainage into it. The tank is divided into three compartments, these being the main separator, fitted with a number of baffle walls and light oil run off tundishes, the liquor sump and the tar sump. On the roof of the tank are situated two electrically-driven tar pumps, one standby to the other, for pumping tar to the tar well and also for scavenging tar from the liquor sump and delivering through the selling line. Also on the roof of the tank are situated two electrically-driven pumps for pumping liquor to the settling tanks.

The tar storage tank is an all-welded steel tank, 20 ft. diameter and 26 ft. high, having a capacity of 50,000 gal. and is situated adjacent to the tar sump on the middle terrace. Space has been left for the future installation of another tank of the same capacity. The tank is fitted with an access ladder to the crown, a pressure and vacuum breather valve, a level indicator, and a run off connection for liquor half-way up the side of the tank.

The three identical liquor settling tanks are all of welded steel construction, 9 ft. diameter and 30 ft. high, having a capacity of 10,000 gal. each, and are situated adjacent to the liquor sump and tar storage tank.

Access to the top of the tanks is made via the tar tank ladder on to a high level platform running along the side of the liquor tanks and supported from them. Each tank is fitted with a level indicator and a tar drain at the base. The 10 oz. liquor storage tank mentioned earlier is identical with these three tanks, and is sited near to them, making up the complete installation of four such tanks.

The effluent filtration tank, 51-ft. long by 7 ft. 6 in. wide, is of reinforced concrete construction, and is arranged below ground level on the low level terrace. The liquor passes through a torturous path of baffles, followed by a coke bed and hessian screens before discharging into the river via a recording flow meter. Provision has been made for the easy digging out of spent coke by sloping the end wall of the coke bay at approximately 45° to the vertical and forming a draining slab for wet coke at ground level.

Gasholder Site

In order to provide an access road to the gasholder site in the quarry, having a slope not greater than 1 in 8, and also, to open out the quarry sufficiently to allow adequate space for the holder itself, it was necessary to excavate some 12,000 cu. yards of material, including the blasting of approximately 3,500 cu. yards of rock. Spoil from the excavations was tipped into a low section of the quarry some 40 yards from the holder site. After completion of the excavations it was found by sinking trial holes, that while rock was present on two sides of the site, a filled valley of soft material ran across the middle of the site which was some 30 ft. deep at the centre and approximately 60 ft. wide at foundation slab level. Underlying the soft material was a very hard igneous rock, quarrying of which in earlier times was, in all probability, the cause of the deep valley which has now been filled in.

The condition therefore existed where high bearing properties of the ground on either side of the site gave way to ground of much lower bearing strength in the central strip, with the resultant risk of differential settlement. The soft material in the central strip contained a large number of hard rock boulders, some as large as 4 ft. diameter, and it was therefore decided not to attempt to pile this soft area as trouble was likely to be experienced in driving straight piles and the operation might become much more expensive than at first envisaged for piling in homogeneous material.

After careful consideration it was decided rigidly to support the walls of the tank, and for a width of 7 ft. around the periphery of the tank bottom, by sinking shafts down through the soft material to the hard rock bottom and filling these shafts with concrete to form piers. Heavy reinforced concrete beams

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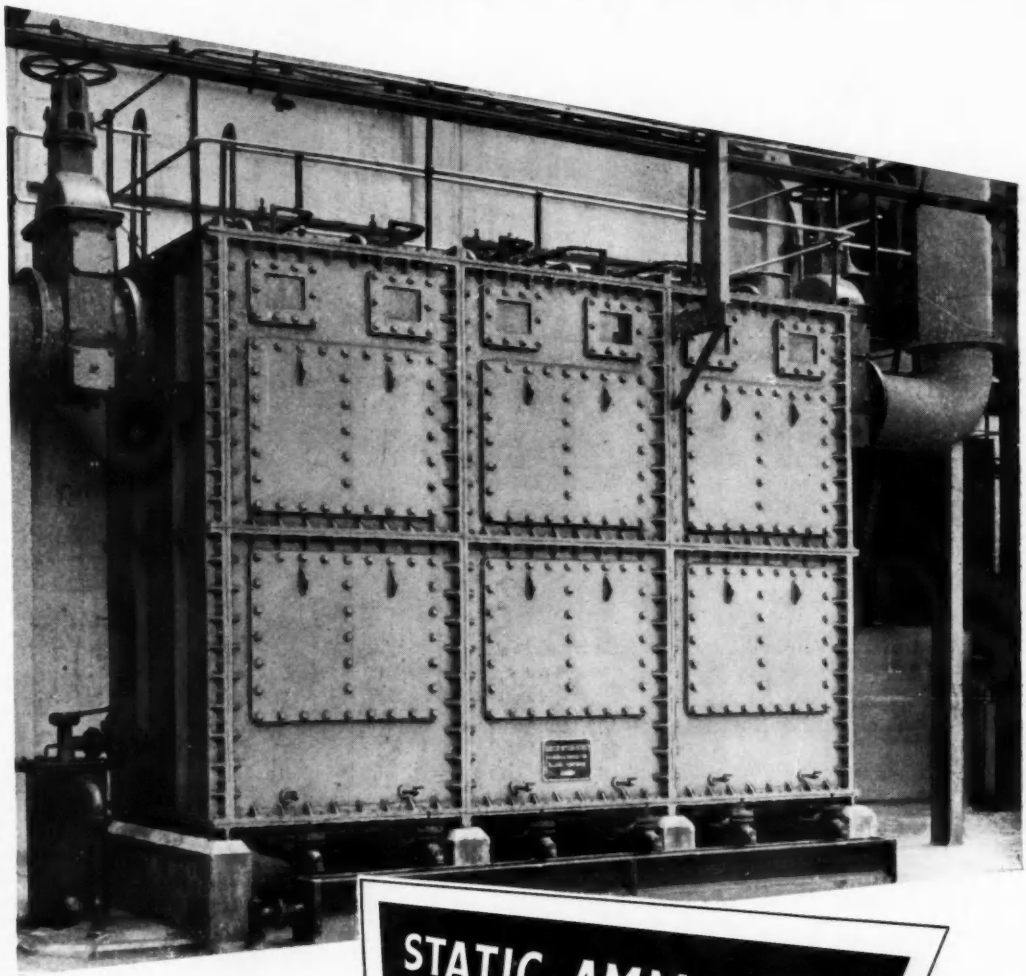

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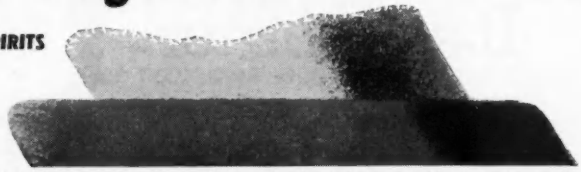

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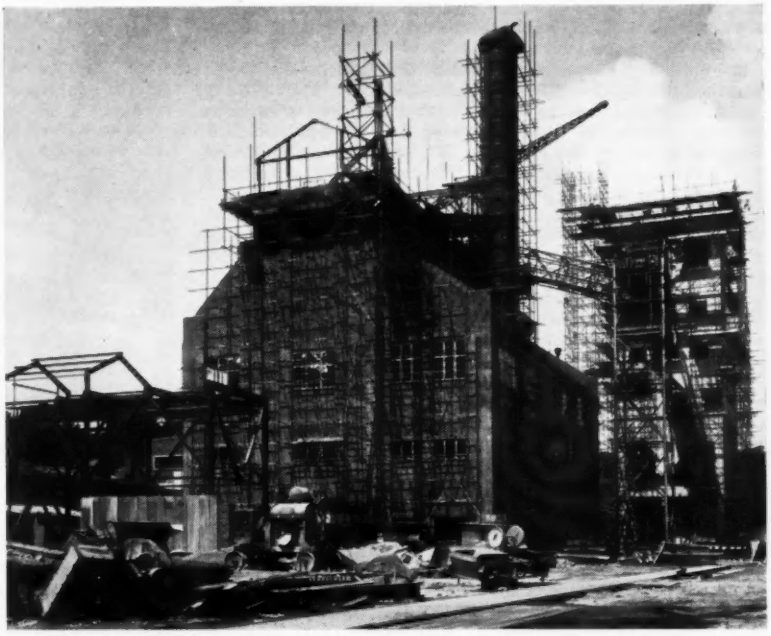

The carbonizing plant and coke bunkers at Truro, showing the stage reached by June, 1956. A feature of the planning is the well-proportioned external appearance and the adequate window space, making for pleasant working conditions.

running between the good foundation on one side, across the tops of the piers, to a good foundation on the other side, were constructed, as additional substructure to the normal foundation slab originally proposed.

It should be noted that no additional support was given inside the peripheral supporting ring, since it was considered that minor settlement in the centre of the tank bottom would not seriously affect the holder structure.

The gasholder is of Whessoe's manufacture and is a three-lift, spirally guided, all welded, holder having a capacity of 750,000 cu.ft. and arranged in a welded steel tank. The inlet and outlet mains are positioned at opposite sides of the tank and no safety seal pipes are required since a natural safety seal is formed by both mains having to rise up over the side of the quarry to a higher level than the water in the tank. The construction of the holder was effected by the use of a power operated Marley derrick, 75 ft. high, with a jib half-way up, which was situated just outside the tank and lifted all the materials into the tank. Sheets and joists were then distributed inside the tank by plating legs running on a peripheral rail. Each lift is constructed to very fine limits, and the maximum allowable error on any radius is $\pm \frac{1}{8}$ in. to ensure easy and efficient operation.

The electric welding was subjected to an X-ray test of 5%, *i.e.*, 1 ft. in every 20 ft. run of weld, and the crown and panel lap joints on each lift are made by continuous welding on the outside and 'tack' or 'stitch' welding on the inside to avoid possible undue stress and distortions in the plates and undercutting of the parent metal. The cups and dips of each lift have been sprayed with aluminium at the wind and water line to minimize the effects of corrosion.

All the gas made will pass into this holder before entering the Truro district holders or being compressed into the integration system, and as the works increases in size this holder will tend to become a balancing and mixing chamber between the works and the compressors.

Administrative Workshop and Stores Building

The construction of the administrative workshop and stores building has not yet been begun, and it is still largely in the design stage. This building does, however, include the workshops, stores, garage for work's vehicles, road weighbridge office, ambulance room, calorimeter room, laboratory, men's messroom, locker room, showers and lavatories, beside the office accommodation for the Group station engineer, station engineer, technical assistants and foreman. Essential accommodation will therefore be provided in the form of temporary buildings and site huts until such time as the permanent building can be erected.

The permanent building is sited at the north end of the lower terrace adjacent to the work's entrance and the road weighbridge. It is to be arranged on two floors with the main entrance facing the entrance road, and a footbridge is to be provided between the first floor and the middle terrace for easy access to the carbonizing plant from the laboratory, technical assistants' and foreman's offices. A second footbridge is provided for access to the men's messrooms, locker room, showers and lavatory, which are also situated on the first floor.

DISCUSSION

The **President,** Mr. D. J. Maunder (Torquay) thought that where new works were envisaged a protective screen of trees was most desirable. Where possible these should be planted immediately the plans had been approved, as a period of from three to five years usually elapsed before construction was completed, and this would provide a valuable start for the trees before production commenced. He would look forward with interest to the results obtained with the Coresil foundations.

Mr. J. B. Rich (Engineer and Manager, Portsmouth Group) said that Mr. Carr had been singularly fortunate in having the experience of seeing a works grow from a virgin site. While in this case one did not have the problems of maintaining an existing works in production while a new works was built round it, there was the difficulty that all operations were carried out practically in a desert—no stores, no workshops, no canteens. In planning, where there was a number of contractors, one had to be very careful to ensure that contractor B began where A had finished.

He was very envious of the granite retaining walls forming the terraces. In the case of the Isle of Wight Central Works, in which he had been concerned up to some three years ago, the terraces were formed by banks at a slope of one in two. Although these had been grassed and extensive drainage work carried out, difficulty was still encountered with slips, and being trained on a West Country works himself, what could be a more obvious solution than the building of a retaining wall? He was afraid, however, that up to the present his efforts had been unavailing in this direction. It would be of interest to have some figures on the costs involved.

With regard to the area of the site, he would be interested to know the ultimate maximum make from the works. As he saw it at present, plans had been laid for an extension to 4 mill. per day. He raised this question as he was interested to know what was considered to be the figure for production of gas per acre of ground. On their Central Works site they had originally only 11¼ acres to make 11 mill. per day, or just over one acre per million, but later they were able to obtain

a further four acres, although the latter did not affect the original planning of the works.

He was very interested to see that only one holder had at present been planned. In the event of this meeting with any disaster requiring it to be put out of commission—for example, a serious leak in the tank or cups, or frost damage—would it be possible to put the make gas into the existing holders at Truro works, from which the compressors could draw their supply?

He noticed that the detarrers had been obtained second-hand from existing works. In his case they had not been so fortunate, and there had been many arguments before they finally decided on a detarrer of the correct rating together with a standby Livesey washer in place of two detarrers. Their arguments for this were that an explosion in one detarrer would in all probability also damage its neighbour immediately alongside. He knew that a Livesey was now considered old-fashioned and obsolete, as well as consuming a lot of power compared with a detarrer, but for standby purposes one could not better its great claim for reliability.

Whereas, in the case of the compressors, they were having, initially, two 100,000 sets with a future 200,000 machine, thereby giving a 100% standby, in the case of the exhausters the future set was the same size as the original machines, i.e., a 50% standby. It could well be that this was bound up with the greater importance of the pumping grid as against the output from the works, but he would be interested to know the reasons for the difference in the amount of standby plant.

Walls Cost £18,000

Replying, the **Author** said that the cost per yard of retaining walls was naturally variable, depending on their height and the pressure of earth behind them. A reasonable figure to take for concrete would be £7 per yard placed, to which would have to be added shuttering and other works which might vary considerably, depending on the site. The walls at Newham cost approximately £18,000. With respect to the area of land employed for gas making at Newham, it should be realized that some of this land was not suitable for building. The main developed area comprised some 4½ acres which would accommodate 2 mill. now, 4 mill. later, and any possible future development, so that in fact the figure of production of gas per acre closely approximates 1 mill. It was possible for the new works to make into the Truro holders and provision had been made for compressing from these holders should the need arise. The 100% standby on compressors was largely influenced by their electric drive, whereas in the case of the exhausters one machine was steam driven, which was considered to be more reliable.

Mr. J. B. Taylor (Bristol) said that it was claimed for Coresil that it would allow no vibrations from the foundation to pass the layer of insulating material, but unfortunately there was no method of studying the effects of this layer, which in practice was only a matter of degree. There was to his knowledge vibration from compressors so treated and this no doubt emanated from the unbalanced forces to be found in a machine of this type. The ultimate answer would appear to be rubber mounting and silentbloc bushes, as employed in the motor industry. The diesel alternator was a unique subject and its operation would no doubt be watched with close interest. It would be interesting to know if automatic self-starting facilities were embodied to allow the standby machine to cut in on an emergency arising.

The **Author** agreed that there was a lot to be said for springs or rubber mountings to obviate vibration on machines, but in the case of gas compressors the main difficulty would be in providing suitable flexible gas connections. This difficulty might well outweigh the advantages to be gained from a completely vibration-free machine. So far as the diesel alternators were concerned, it was envisaged that due to other considerations these would be under the permanent supervision of an attendant, who would be in the position to take immediate action as and when emergencies arose.

Mr. W. Mew (Plymouth) wondered if any particular precautions were taken to prevent the foundation reinforcing bars damaging either the asphalte or Coresil lining. He noted that the holder had been metal sprayed after sand blasting, and wondered how this coating was standing up, as he was given to understand that changes of temperature after sand blasting were liable to render the coating non adhesive.

The **Author** said that no particular precautions had been taken in respect of damage to the asphalte or Coresil, but a close examination before concrete was poured showed no defects. In regard to the aluminium coating on the holder cups and grips, it had been necessary for construction purposes to weld metal lugs to these, to allow them to be swung into position by crane and the greatest difficulty had been experienced in removing the aluminium coating at the points where these lugs were welded on so that it would seem any fears in this direction were groundless.

Granite Rejects

Mr. W. Dougall (Station Engineer, Truro) said that Mr. Carr had carried out the original survey and designed and built the retaining walls and throughout the construction had been available to guide and advise. It might be of interest to members to know that the use of granite rejects for the construction of the walls had resulted in a saving of some £1,500 against the use of concrete. Regarding the question of standby for the electric detarrer, this was largely decided by the fact that redundant plant was available.

Mr. James Carr (Deputy Chairman, S.W.G.B.) said how gratifying it was to know that despite the very difficult nature of the site which demanded the very accurate placing of levels, the original survey had been so good that no difficulties had been experienced by the various contractors when they came to erect their plant. It should further be noted that the employment of redundant plant in new work created further difficulties, but the saving of between £15,000 and £20,000 was well worth the extra effort involved, especially when one considered the amount of gas it would be necessary to sell to provide this profit.

NEW DIESEL SHUNTER

THE first two prototypes of a new design of diesel locomotive have recently been produced by Peckett & Sons, Ltd., at their Bristol works. For the first time a fully automatic mechanical transmission has been developed for locomotive work, offering the ease of control of an electric or hydraulic system coupled with a high transmission efficiency and simple robust parts.

The locomotive, which is nominally of 200 h.p., has an overall weight of 32 tons and is designed for industrial shunting. It has an overall length of 20 ft. 4 in. with an 0-4-0 wheel arrangement and a wheelbase of 5 ft. 6 in. which allows it to traverse a minimum curve of 50 ft. radius. The wheels, of 3 ft. 2½ in. diameter, are driven by connecting and coupling rods from a jackshaft at the rear end. The engine, gearbox and auxiliaries are mounted under a bonnet which has four access doors on either side and large double doors in the roof to facilitate engine maintenance. The cab is of ample size and has large windows on all four sides. Special attention has been paid to good visibility from the driving position, and a clear view is obtainable, both over the bonnet and to the rear.

The locomotive has a top speed of 13¾ m.p.h. which is quite sufficient for most industrial shunting. The bottom gear tractive effort is approximately 19,000 lb. There are four gear ratios, namely:—4:1, 2.54:1, 1.57:1, and 1:1, with a final drive ratio of 10:1 from the gearbox to the rail wheels. These ratios can, of course, be varied to suit particular applications, with corresponding variations in the maximum speed and tractive effort. The two prototype locomotives differ in that one is fitted with a Gardner type 8L3 engine developing 204 b.h.p. at 1,200 r.p.m., and the other with a Crossley type EST 4 developing 220 b.h.p. at 750 r.p.m. By means of a different ratio in a pair of transfer gears the input shaft of the gearbox is in both cases driven at a maximum speed of 1,200 r.p.m. In all other respects the two locomotives are similar. The design has been arranged so that other well-known makes of diesel engine can also be accommodated.

The four-speed automatic gearbox has been developed by Hobbs Transmission, Ltd.; in conjunction with Peckett & Sons, Ltd. In general principle, it is similar to Hobbs transmissions fitted to road vehicles and to certain armoured fighting vehicles and heavy earth moving equipment, though the present application differs considerably in detail.

Control of the engine is achieved by two levers only, the throttle and the reversing lever, the gear changes being auto-

matic. The gearbox consists of a planetary gear train, and a set of oil-operated clutches and brakes which drive or hold various parts of the gear train to provide different ratios. A governor valve is controlled by the pressure from an oil pump driven from the output side of the gearbox, so that its position varies with the running speed of the locomotive. The governor valve in turn directs the flow of oil from another oil pump (driven from the input side of the gearbox) to the relevant clutches and brakes for a particular gear ratio.

The hydraulic control is designed to give an overlap between the release of one gear ratio and the engagement of the next, so that continuity of traction occurs. Upward changes take place at higher speeds than the corresponding downward changes, avoiding the possibility of hunting between two gears on a gradient. The engine is idling and picks up the drive smoothly as the engine speed increases. All clutches and brake surfaces run in an oil lubricated condition so that wear of linings is negligible. Pressure is applied by diaphragms of large area, with correspondingly low operating pressures.

Reversing is accomplished by clutching in alternative spiral bevel gears in the final drive, the hydraulically operated clutches being of similar design to those in the gearbox. They are interlocked with the gearbox so that engagement or release can only occur when the engine is at idling speed. It is not necessary, however, for the locomotive itself to be completely at rest when reversing, so that a rapid change of direction can be accomplished. Power is transmitted from the engine to the gearbox by means of a Layrub flexible coupling. This coupling also carries a pulley for driving the air compressor. The fuel tank of 220 gal. capacity is mounted under the bonnet just forward of the driver's cab. The controls are duplicated on either side of the control desk so that the locomotive may be driven with equal ease from each side of the cab.

These locomotives have been designed for industrial shunting, a field in which Peckett & Sons, Ltd., have many years of experience. The primary considerations throughout have been simplicity, robust construction and easy maintenance, to be achieved at moderate cost. The design, however, is capable of ready adaptation for other applications. At the present time two smaller versions of 100 h.p. and 150 h.p. respectively are under development, and it is intended to develop the range in an upward direction as soon as possible.

Modern Development in Low Temperature Carbonization*

By T. BIDDULPH-SMITH, F.R.I.C., F.Inst.F., F.C.S., M.Inst.Gas E.,

Station Engineer, Partington Works, North Western Gas Board

THE early workers in this field of low temperature carbonization appreciated the effect of temperature upon the qualities and quantities of products produced, and this was evaluated by C. B. Marson[1] who, with a Nottinghamshire medium coking coal, obtained figures from which the graph Fig. 1 was prepared. From this graph it will be seen that in the region of 700°C. there is a critical temperature, above which decomposition of the evolved volatiles by secondary reactions take place. For this reason the low temperature process of carbonization has been limited to a maximum temperature in the region of 700°C.

It was quickly discovered, however, that heat penetration into the charge at this temperature was so slow that the process became economically impossible, and many and various methods were tried to accelerate this.

Tozer introduced metal ribs into Parker's tapered iron tubes to facilitate heat transmission into the charge, while Illingworth lined a vertical refractory retort with tapered cast iron joists to form many smaller retorts with the same object in view.

Later the author and his colleagues introduced at Barugh collapsible plates into a vertical retort, as shown Fig. 2, which held a layer of the charge in position adjacent to the walls during carbonizing, and which later could be collapsed to allow the fuel to discharge into the cooling chamber below.

Many processes such as the 'Carbocite' system pretreated the fuel either by fine grinding and oxidation, preheating, or blending with non-coking material in order to reduce the impermeability of the plastic layer and allow the evolved products to freely pass through the charge, thus using these gases to carry heat into the charge. Unfortunately the amount of gases evolved at temperatures in the region of 700°C. are small, and as the heat transferred did little to increase the speed of carbonization, the cost of the preliminary treatment of the coal was greater than the saving from carbonization acceleration.

Many ingenious efforts have been made to carbonize coal in thin layers, for example, the Caracristi process operated at the Ford Motor Works, Detroit, U.S.A., where the coal was conveyed in ½ in. layers on a metallic conveyer, through a 40 ft. long distillation chamber consisting of a bath of molten lead, but the many complications involved led to the discontinuance of these processes.

Many inventors have produced retorts of the producer type. Typical of these is the 'Lewis' generator, patented in 1913, which consisted of a coal-fired step grate producer, from which such proportion of the coke as was considered advisable could be withdrawn through an outlet shown at 'd,' Fig. 3, the remainder passing forward to be burnt on the grate.

Combustion gases from here carry heat up through the charge, effecting carbonization in the high zone above the outlet 'd,' and mix with the distillation products, which after treatment are used for any external purpose.

The most recent development using these principles is the 'Rexco' plant at Mansfield[2], where firebrick-lined cylindrical retorts 24 ft. high and 11 ft. diameter, with no external heating flues, are in use.

These are filled with coal, generally of the weakly caking variety, to a point leaving a free space below the dome where a portion of the gas produced in the process is burnt with air, the products of combustion passing downwards through the charge to the outlet at the base, from which they are drawn by exhauster and passed through a normal tar and liquor extraction plant.

Although the fuel obtained is stated to be of excellent quality, the process produces gas of low calorific value (140 B.Th.U. per cu.ft.), so that such plants can only be sited where large quantities of this low-grade gas can be economically

* Presented to a joint meeting of the Coke Oven Managers' Association (Midland Section) with the Institution of Gas Engineers (Manchester and District Section and Midland Section) and the Institute of Fuel.

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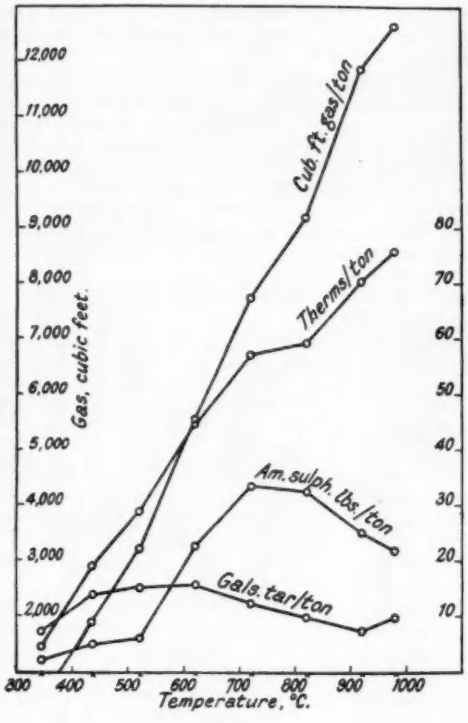

Fig. 1.

utilized. Coalite & Chemical Products, Ltd., one of the largest producers of low temperature fuel today, are using a type of retort very similar to that described in Parker's original specification of 1906. The settings, however, have been modified to ensure the retorts being heated only by radiation.

From the above brief historical notes of the process it will be seen that despite the efforts over the past half century, the difficulty of obtaining rapid heat penetration without causing other disadvantages still hinders its successful and economical development. Although several processes are still being worked, producing excellent fuel, it cannot be produced and marketed as economically as is the case with high temperature carbonization.

The 'Rochdale' Process

During the past few years the Technical and Planning Division of the North Western Area Gas Board has developed a method of carbonization known as the 'Rochdale' process, for the purpose of increasing the throughput of normal gas-making continuous vertical retorts, which has been so successful that the throughput can be increased to as much as 100% above the nominal figure for which the retorts were designed.

The operation of this process has been fully described in the Technical Press during the past two years[3, 4, 5] and the author feels it will be sufficient here to give a very brief resumé of the principles involved.

When working normally, steam is admitted at the base of the continuous vertical retorts to reclaim the heat from the coke before it is discharged, and the heated steam then reacts with the hot coke higher up the retort to produce carbon monoxide and hydrogen. Regulation of the amount of steam admitted also controls the calorific value of the mixed gases evolved to the declared or required standard. The reaction between steam and coke is, however, endothermic, and absorbs much of the heat presented at the retort walls, so that the throughput of the retort is proportionately reduced.

The 'Rochdale' process replaces steam by gas—blue water gas and producer gas are both being successfully used, and as these gases do not react to any extent, all the available heat presented to the coal charge is utilized for carbonizing.

Increasing the amount of carrier gases passing up the retort increases the speed of carbonizing, and 5,500 cu.ft. per hour per retort, gives at Partington a continuous throughput of 14-15 tons per retort per day, compared to the nominal figure of 7-8 tons per retort per day with normal steaming to produce 450 B.Th.U. per cu.ft. gas. Incidentally, the same amount of labour is required to operate the retorts whether they are recycled or working normally.

The advantages of the 'Rochdale' process will be apparent. The saving of capital expenditure and the increased economical flexibility of production to seasonable requirements being of first consideration. It is possible to inject into the retorts blue water gas, producer gas, coal gas, or any desired mixture of these, the intake of these gases being measured by Connersville meters. Should such a mixture of gases be required, it is regulated by a diaphragm pressure governor on the blue water gas stream, and a volumetric governor on the coal gas or producer gas stream, and these separate or mixed gases are controlled by volumetric governors to individual retorts. Possible danger from explosion during the intermittent discharge of the retorts is efficiently guarded against by a system of steam purging, which ensures that the coke discharge door cannot be opened until the supply of injection gas has been cut off, and the coke chamber purged by steam. The gas supply cannot be resumed until the door is closed, and any infiltered air is similarly purged away. This is done by a control unit worked by hydraulic power and suitable time switches which makes the procedure simple and positive.

The timing of the purges is performed electrically. The first purge period is initiated by a pressure actuated switch which comes into operation when the purge steam is flowing, and the second purge, *i.e.*, that after discharge, is started by the action of the discharge door opening and closing.

The coke transfer car connecting the retort outlets with belt conveyors is push button controlled, self-positioning, and works on the principle adopted by automatic lifts.

The process is now one of proved normal practice, and is in general use and of great assistance to us at Partington Works.

Low Temperature Practice

The present national demand for smokeless fuel suitable for domestic use, together with the growing requirements for low temperature oils led the North Western Gas Board to extend the 'Rochdale' process to low temperature practice, assuming their proved acceleration process would at least overcome the previously described difficulty of heat penetration. The 'Rochdale' process has therefore been applied to an installation of Woodall Duckham 82 in. 'lambent' heated retorts, which consists of 32 retorts arranged in two benches of 16

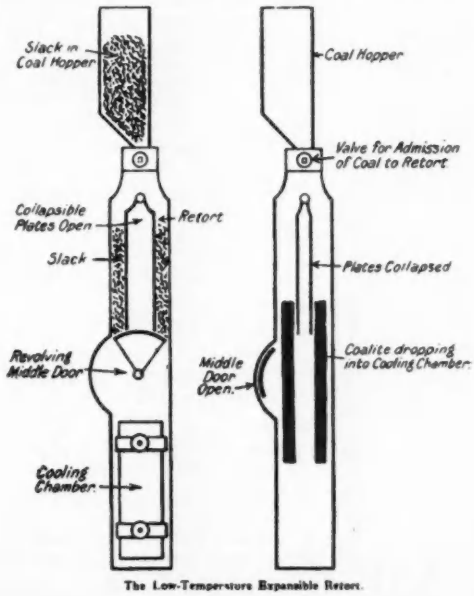

Fig. 2.

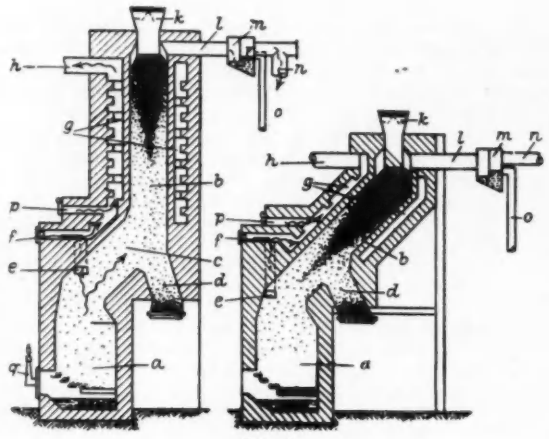

Fig. 3.

retorts each. The temperature of the flues of a section of this Woodall-Duckham continuous vertical retort installation was reduced to about 830°C. and 8,000/10,000 cu.ft. per hour of blue water gas was injected to each retort.

At these temperatures and under these conditions it was found possible to carbonize 8 tons of coal per retort per day, which is slightly above the nominal throughput of the retorts when working normally at the higher temperatures and steaming down to give a gas of calorific value of 450 B.Th.U. per cu.ft.

Movement of the charge through the retorts under these conditions was almost normal, and caused little unusual difficulty. 'Trunk' feeds had been installed to these retorts to ease the top working when on the 'Rochdale' process. Bird and Hardman described these in their recent paper.

While we have used typical Yorkshire coals, having similar swelling characteristics, with satisfactory results, most of our comparative work has been carried out with Annesley D.S.W. small nut coal, which is fairly typical of gas making coals from the East Midlands. This coal with a grading of 83% on a $1\frac{1}{2} \times \frac{5}{8}$ in. screen has a swelling index of 3/3.5 and a volatile content of 34.2%. The low temperature fuel with a volatile content of 10.3% (moisture free) has a grading of 80% above 1 in. and only yields 4% of breeze.

'Thermalite'

The fuel, provisionally called 'Thermalite,' can be used in any normal fire grate, and it is significant that it does not require grading into sizes to suit different grates and chimney draughts, as is often the case with high temperature gas coke. Pieces from 4 in. to 6 in. down to $\frac{1}{2}$ in. in mixture can be easily and completely burned in almost every kind of grate, to give a hot bright fire.

The open fire test was carried out on a standard appliance 16 in. Fulham grate, the fuel being compared with standard open fire test coke.

From the results obtained the following points are the more noticeable:—

1. The calorific value of the 'fuel' is 13,340 B.Th.U. per lb. compared with 12,950 B.Th.U. per lb. for the coke obtained at high temperature from the same coal.
2. The bulk density of the 'fuel' is only 16.8 lb. per cu.ft. compared with 24.66 lb. per cu.ft. for high temperature coke from the same coal.
3. The speed of ignition and the time for the fire to arrive at a radiation of 5,000 B.Th.U. per hr. was reduced to a point far below expectation.
4. The maximum radiation for the 'fuel' in the second period, which rose to 14,900 B.Th.U. per hr.

These first practical scale runs suggest the injection gases streaming through the charge may increase the total porosity of the fuel by 'blowing up' the coal mass during plasticity, and thus proportionately increase the combustibility and rate of ignition.

While this is most desirable, it can only be at the expense of the period a useful fire can be maintained without replenishing and the question to be decided is how far we should improve combustibility of the fuel at the expense of the length of unreplenished useful fire.

The continuous vertical retort, therefore, offers certain advantages towards the successful working of the low temperature process, because of the comparative ease with which temperatures can be controlled throughout its length. Added to this, the simple and accurate control of throughput, and the positive control of the amount of injection gas, make it much easier to ensure that the residual volatile matter, deposition of carbon from secondary reactions and bulk density, all of which are the main factors governing combustibility, are as specified for a satisfactory fuel. Our intention is to carry out a series of tests, showing how combustibility of the fuel varies in relation to these factors.

At Partington Works where we have a fairly large intake of rich tail gas from an adjacent oil cracking plant it is quite simple to recycle large quantities of gases of low calorific value and still retain our declared standard, but were this not so we should be restricted in the number of retorts we could have working on the process.

It is our intention therefore to recycle varying mixtures of blue water gas and coal gas to ascertain to what extent, if any, hydrocarbons contained in the latter are decomposed at these low temperatures, since should this be negligible the process could be successfully operated without external enrichment.

The North Western Gas Board feel therefore as the application of the 'Rochdale' process to Low Temperature practice is so full of promise in simplifying the problem of heat penetration, and process so easy of application using the most suitable existing plant, that these results should contribute to the national endeavour to encourage the use of smokeless fuels, and to ensure a sufficient supply of a suitable product.

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5. J. P. Bird and F. Hardman. 'Commissioning of the First Commercial Scale Rochdale Process Plant'. Manchester Junior Association of Gas Engineers March, 1955.

Burner Conversion to Natural Gas

Discovery of natural gas in Germany has led to its increasing use for industrial furnaces, and over 5,000 mill. cu.ft. were produced in 1954. The higher calorific value compared with long distance grid gas entails a saving of 35% in cu.ft. required for the same heat effect, while its Wobbe index lies only $8\frac{1}{2}$% higher. The velocity of ignition of natural gas is, however, only about one-third of that of grid gas and a greater inclination for the flame to become detached from the burner jet may be expected. The minimum amount of air required for complete combustion rises from 4.1 cu.ft. to 7.1 cu.ft. per cu.ft. of gas, but based on 1,000 B.Th.U. the amount of air required is only 10% higher. After an investigation of all types of industrial burners the conclusion was reached that the main difficulty for successful conversion of industrial burners from grid gas to natural gas lies in the slower ignition velocity. Owing to the absence of H_2, the presence of 25% of inert gases and the exclusive reliance on CH_4 as the agent for the combustion, the latter takes place somewhat later and within a smaller space. Excessive heat losses, too high a flow velocity, or imperfect mixture may easily cause the flame to become detached from the burner jet. The following remedies are suggested: (1) Reduction of flow velocity by enlarging all cross sectional areas, or surrounding the gas/air mixture with an ignition flame; (2) better mixing effect by greater kinetic energy of gas and air streams and less oblique angle between them, and provision of an anti-chamber, or turbulent introduction of gas and air. It is stated in conclusion that conversion from grid gas to natural gas does not normally cause any difficulties and that extensive burner modifications will be required only where ignition velocity is the decisive factor.

M Muhr: *Gaswärme*, Vol. 5, No. 3, March, 1956, p. 81.

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Liquid Gas . . . an investigation

PART III.
State of the Arts

By JOHN D. CRECCA, Jnr.

THE idea of liquefying natural gas had its foundation in the work of Faraday on critical pressure and temperature and Mendeloff's study of heats of vaporization[7]. In 1872 Caillet in Paris and Pictet in Geneva produced a fog of oxygen by a sudden release of pressure. Ten years later, in Crakow, Olszewski and Wrobleski produced liquid oxygen using the evaporation of ethylene to obtain the low temperature. It was at the turn of the century that Linde worked out a process of liquefying air by the use of the Joule-Thompson effect. Linde was the first to make commercial use of air liquefaction process. Claude later improved on Linde's process by adding an expansion engine to the system. This was in turn modified by Heylant.

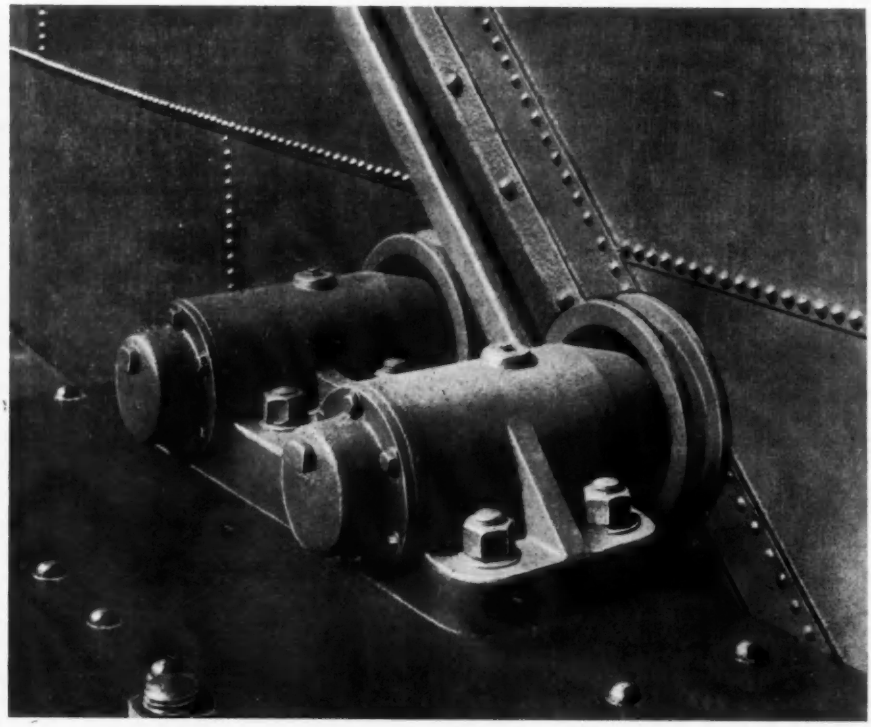
World War I was the starting point of the low temperature development in the United States. Airships seemed to be a potential factor in changing warfare. Hydrogen was used in the bags but it was too inflammable. Helium was found to be a very satisfactory replacement, but it was a rare element in the air. It was discovered that some natural gas wells contained 0.1% to 1% and even 2% helium. The United States Bureau of Mines developed a practical process for extracting helium from the natural gas around Amarillo, Texas.

In 1937 the first investigations into the commercial possibilities of liquefaction and storage of natural gas were made by the Hope Natural Gas Company. After two years of laboratory work, a pilot plant was built in Croton, West Virginia, with a capacity to liquefy 400,000 cu.ft. per day. A number of technical difficulties were encountered, such as the need to remove CO_2 and water from the natural gas before it was liquefied and the chemical composition of the steel.

In 1940 the East Ohio Gas Company found that it needed a method to provide for peak loads. In addition to supplying industries in such cities as Cleveland, Akron, Canton, and Massillon, the Company also supplied domestic demands. It was found that during periods of severe cold, the Company could not supply all the customers' needs.

A number of alternatives were investigated to solve this problem. Such plans as a 12-in. high pressure storage line, underground storage, and high-pressure storage in the main line were considered. However, it was at this time that the Hope Natural Gas Company completed its investigations. This seemed to be the answer to the problem. In January, 1941,

7 Haynes, P. E. *Gas Age*, Vol. 87: pp. 43-49, May 8, 1946.



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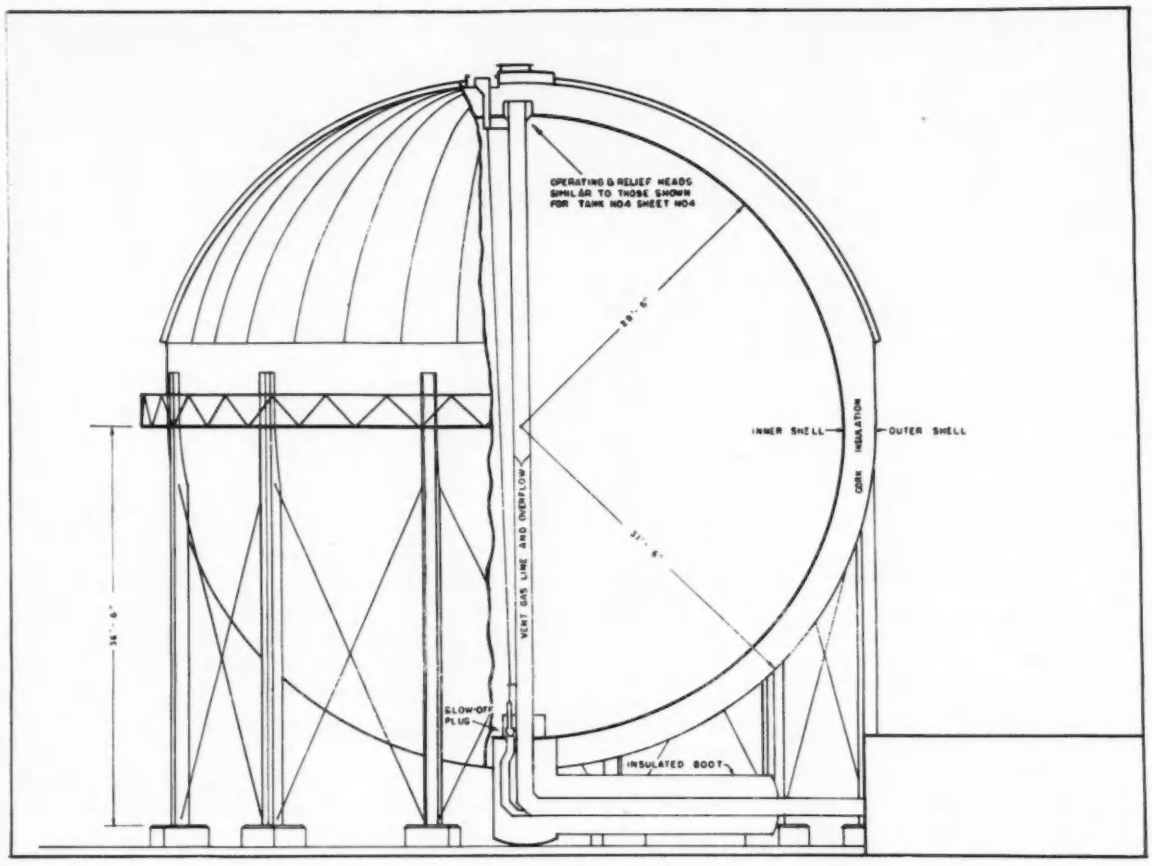


Fig. 1.

a $1\frac{1}{2}$ mill. plan, which included equipment to liquefy 4 mill. cu.ft. per day and three 50 mill. cu.ft. storage tanks (this is the volume of free gas—*i.e.*, after it has been vaporized) was completed in Cleveland. Later another tank capable of holding 100 mill. cu.ft. was added. The plant was operated successfully until October 20, 1944, when a fire and explosion damaged or destroyed six to eight million dollars' worth of property and took 130 lives. This resulted in a loss of interest in this process for a time.

It will be helpful in the final design if the disaster and the system is analyzed.

In Cleveland the liquefaction process used consisted of an ethylene-ammonia cascade system and the vapours from the storage tank and the primary liquid tank were used as coolants in the cascade system.

There was a cylindrical tank and a number of spherical tanks (Fig. 1); the latter remained intact while the former exploded. The inner shell was made of $3\frac{1}{2}\%$ nickel steel with 0.08 to 0.12% carbon while the outer shell was constructed of standard carbon steel. About a year before the explosion a crack occurred in the bottom of the cylindrical tank. It was a later failure in this tank that resulted in a spilling of its contents and the subsequent disaster.

The tank designers believed that $3\frac{1}{2}\%$ nickel was sufficient because the A.S.M.E. codes were satisfactory to $-150°$F. and 18-8 stainless steel would be difficult to weld. However, two factors were overlooked. The first was the ductility of the metal at low temperatures. A general conclusion covering the value of the impact test at low temperatures cannot be drawn for all heats of a particular alloy, from one heat, as the value will vary with the heat. Also, below $-100°$F. the variation is large. Thus, it would not be satisfactory to exterpolate values from a limited curve[8, 9]. The second factor overlooked is the ability to weld stainless steel. A 25-20 rod would be satisfactory steel.

The fragments of the tank found in the area seem to bear out the idea that the metal selected was poor. The edges looked like a glass fracture indicating a fracture due to brittleness.

Rockwool insulation was used in the cylindrical tank. There were occasions when frost spots appeared on the tank. An additional two car-loads of rockwool were added to the tank, after a period of use, because the rockwool settled up to 8 ft. in some places.

The spherical tanks were insulated with granular cork except near the bottom. Here corkboard was used to support the inner shell. The fire proved the worth of the cork insulation. Only one spherical tank failed during the fire and this was a result of the supports melting from the heat—not a heating of the liquid in the tank.

This last point brings out another poor design factor. All the tanks were within 20 ft. of each other and in the middle of a populated area. There were homes and factories within 150 ft. of the storage tanks. A plant of this type should have been located in a more isolated spot. The National Fire Protection Association recommends that a distance of not less than twice the largest dimension separate the storage tank of such volatile liquids from the nearest tank or building.

Thus, it appears that the plant failed, not because the idea was poor, but because of errors in the design. Neither the Report of the Technical Consultants for the Mayor of Cleveland nor the Bureau of Mines Report of Investigation[10], from which the information on the disaster was obtained, condemn the process. It is the manner in which it was set up that they questioned.

8 Armstrong, T. N., Gagnebin, A. P., American Society for Metals Transactions, Vol. 28: pp. 19-24, March, 1940.

9 Gillett, H. A., Project 15 of the Joint ASME-ASTM Research Committee.

10 Elliott, M. A., Seibel, C. A., Brown, F. A., Artz, R. I., Berger, L. B., 'Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant at East Ohio Gas Company, Cleveland, Ohio', Report of Investigations 3867, United States Bureau of Mines, February 1946

The most recent undertaking involving the liquefaction of methane is by A. L. Morrison and Associates of Lake Forrest, Illinois. He proposes to liquefy methane obtained from natural gas wells in Louisiana. He has mounted his machinery on a barge so that it may be moved from well to well. The transportation barges are 260 ft. long and 54 ft. wide. Each has five balsa wood lined cylindrical tanks giving the barge a capacity of 870 long tons, or 18 mill. cu.ft. of free gas. The gas is to be transported to Chicago. In regasifying the methane, he plans to cool brine to be used in the meat storage plants[11, 12].

It is understood that the method to be used by Morrison is somewhat similar to Figure 2. There appears to be two weak points. Apparently, the system was designed upon the basis of receiving well-head gas which may be about 2,500 lb. per sq. in. absolute. After purifying the gas and removing the higher hydrocarbons, the methane pressure is reduced to about 1,000 lb. per sq. in. absolute. However, the pressure of gas wells have been known to drop at a rate that has prompted much investigation into portable gasoline plants as early as 1925. Hence, many good wells would have to be abandoned in this system depending upon a high well pressure.

The second weak point lies in the turbo-expander. When expansion of the methane reaches the heterogeneous region where there is a mixture of vapour and liquid, this requires a special turbine design and reduces the efficiency.

The shipping of liquefied gases by ocean going vessels has already been accomplished. However, the gases are propane and butane, which can be liquefied under pressure. Two dry cargo ships have been converted. They have been fitted to carry bottles ranging from 8 to 13 ft. in diameter, and 25 to 48 ft. long. One ship has a capacity of 38,065 barrels, the other 17,000 barrels. A Swedish ship, designed especially to carry liquid propane, was built in 1953. It is much smaller than the others since it may carry only 7,000 barrels.

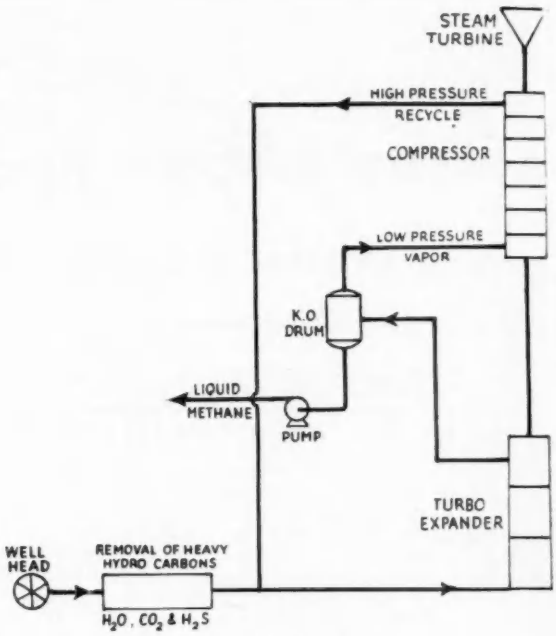


Fig. 2.

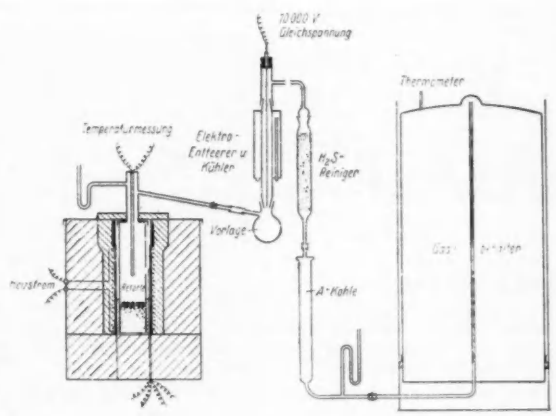
(To be continued)

[11] 'Barge Shipment of Natural Gas', *Chemical and Engineering News* Vol. 32: p. 1421 (1954).

[12] Nelson, W. T., *Oil and Gas Journal*, Vol. 58: pp. 124-125 (July 12, 1954).

Laboratory Gas-Distillation Apparatus

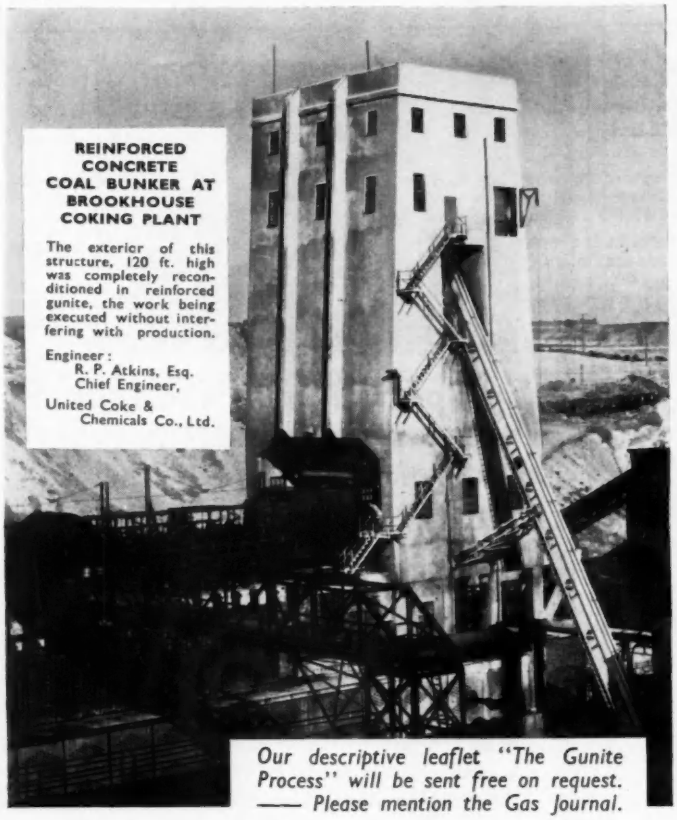
THE apparatus in question is, in effect, a miniature gas plant intended to reproduce on a laboratory scale, and under controllable, comparable conditions, the full-scale, industrial process. The requirements for such an apparatus are stated as: Complete distillation of the coal; recovery of the primary volatiliation products in such a form that the *gas benzene* is nearly entirely *aromatic* in character; highest possible (nearest the theoretical) volumetric gas yield and calorific power. An apparatus of this kind was already in operation at the Berlin gasworks by 1930, but difficulties encountered, particularly with regard to the aforesaid conditions of by-product recovery, suggested various alterations, resulting in the apparatus now illustrated here. The coal sample, about 1 lb. (400 gr.) in weight, is pulverized to 3 mm. (.118 in.) mesh and introduced into a steel retort which is placed in a resistance-heated muffle. The lower part of this vertical retort, is heat-insulated by pure asbestos fibre. This is the particular, novel feature of the new apparatus, intended to prevent overheating of the coal-filled portion of the retort before the 'gas head' in which the distillation products collect, has attained full working temperature; otherwise, either the gas head experiences low-temperature distillation conditions, or 'overcracking,' in particular of the gas benzene, can take place by overheating. Both have an unsatisfactory influence on the yield, and represented, in fact, the disadvantages attending the use of the previous apparatus. The tar separator is of the electrostatic type. H_2S is removed by gas purifying mass in the usual manner, and an activated-carbon filter follows these two purifiers. The cleaned gas is collected in a bell receiver or gasholder, and the by-products recovered from the purifiers by usual laboratory methods, for measurement and analysis. Test results show the requirement of reproducibility to be well fulfilled: it has been possible to reproduce the gas value within ½% of the average. Similarly, benzene 'overcracking' has been entirely eliminated. The correspondence with full-scale yields and conditions is surprisingly good, and the results by comparison with other distillation techniques, likewise very satisfactory.



A diagrammatic view of the improved gas-distillation apparatus.

Retorte	Retort
Temperaturmessung	Temperature measurement
Heizstrom	Heating current
10,000 V Gleichspannung	10,000 volts direct current
Elektro-Entteerer und Kühler	Electrostatic tar separator and cooler
H_2S Reiniger	H_2S purifier
A-Kohle	Activated carbon
Gasbehälter	Gasholder
Thermometer	Thermometer
Vorlage	Receiver (collector).

S. Schubert: *Das Gas-und Wasserfach*, Vol. 97, No. 5, March 1, 1956. Pp. 176-182.



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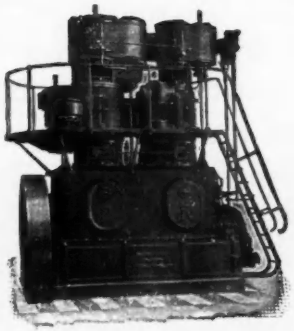

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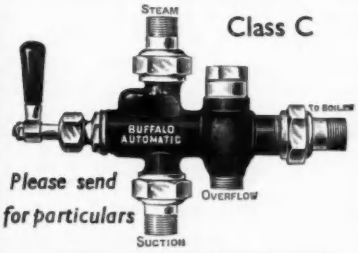

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ESTIMATOR.—Preferably with experience in Industrial Pipework layouts, required for company with Headquarters in the North West. Apply: No. 285, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

THE Solid Smokeless Fuels Federation invite applications for the post of MANAGER of the Federation. Applicants will be required to show sound organizing and administrative ability and should be experienced at carrying out negotiations with Government Departments, Local Authorities and national fuel organizations. They should have a wide technical knowledge of solid fuel appliances in domestic and commercial usages. Salary will be in the region of £1,400 per annum, according to qualifications.

Applications should be made in writing to the Chairman, Solid Smokeless Fuels Federation, 74, Grosvenor Street, London, W.1, to arrive not later than July 7, 1956. Envelopes should be marked "Vacancy."

SCOTTISH GAS BOARD

KILMARNOCK GROUP
GROUP DISTRIBUTION SUPERINTENDENT

APPLICATIONS are invited for the position of GROUP DISTRIBUTION SUPERINTENDENT for the Kilmarnock Group.

The salary will be within A.P.T. Grade 10, Provincial 'A,' with placing according to qualifications and experience.

A modern house is available, at a reasonable rent, to the successful candidate.

Applicants should possess the Higher Grade Certificate (Supply) of the Institution of Gas Engineers, or an equivalent qualification, and should be experienced in all branches of gas utilization and transmission at both low and high pressures. Sound training and experience in the planning, estimating and supervision of distribution systems is essential.

The post is superannuable and the successful candidate may be required to pass a medical examination.

Applications stating age, qualifications and experience, together with the names of two referees, should be addressed to the undersigned within 14 days from the appearance of this advertisement.

ROBERT FIFE,
Group Manager.

Riverbank Gas Works
Kilmarnock.
June, 1956.

TECHNICAL ASSISTANT required in the Gas Council Coke Technical Department. Knowledge of the combustion processes involved in the use of solid fuel on Industrial Furnaces and boilers would be an advantage. The officer appointed should be prepared to travel within the U.K. and to assist in the testing and commissioning of industrial plants. Pensionable post. Salary within range £930-£1,055 p.a. Applications, giving age and details of qualifications and experience to the Gas Council, 1, Grosvenor Place, London, S.W.1.

EAST MIDLANDS GAS BOARD

LINCOLNSHIRE DIVISION
WORKS SUPERINTENDENT—GAINSBOROUGH

APPLICATIONS are invited from suitably qualified persons for the post of WORKS SUPERINTENDENT at Gainsborough. The appointment will be made within Grade A.P.T. 8, salary range £710/£790 p.a., and the commencing salary will be commensurate with the qualifications and the ability of the person appointed.

Applicants should preferably hold the Higher National Certificate in Gas Engineering, have practical experience of a modern gasworks, with special reference to continuous vertical retort practice and auxiliary carburetted water gas plant, and also have the ability to control labour.

The position is pensionable, and the successful applicant will be required to pass a medical examination.

Applications, giving details of age, education, training, qualifications and experience, together with the names of two referees, should be addressed to reach the undersigned not later than June 30, 1956.

BERNARD CLARKE,
Divisional General Manager.

Belle Vue House,
Carline Road,
Lincoln.

EAST MIDLANDS GAS BOARD

SHEFFIELD AND ROTHERHAM DIVISION
SUPERVISOR—PUNCHED CARD INSTALLATION, SHEFFIELD

APPLICATIONS are invited for the position of MALE (or FEMALE) SUPERVISOR of the Punched Card Installation in the Sheffield Offices at a salary in accordance with Grades A.P.T. 7 and 8 of the National Salary Scales for Gas Staffs (Males £670-£790 per annum. The female scale begins at £572 per annum and rises eventually to the maximum of the Male scale).

Candidates should be experienced in the control of staff and capable of utilising to the full the comprehensive 65 column installation at present in use.

The installation handles analysis of all expenditure, hire purchase accounting, remittance statements, etc., and it is desirable that applicants have a knowledge of accountancy.

The post is pensionable and the successful applicant will be required to pass a medical examination.

Applications, stating age, education, qualifications and giving details of experience, together with the names and addresses of two referees should be addressed to reach the undersigned not later than July 2, 1956.

C. C. WOOD,
Divisional General Manager.

Commercial Street,
Sheffield, 1.
June 8, 1956.

EAST MIDLANDS GAS BOARD

SHEFFIELD AND ROTHERHAM DIVISION
ACCOUNTANT (COSTS AND EXPENDITURE)

APPLICATIONS are invited for the position of DIVISIONAL COST ACCOUNTANT in the Sheffield and Rotherham Division at a salary within the range of £1,025/£1,265 per annum. The commencing salary within that range will be commensurate with the qualifications and experience of the successful applicant.

The Cost Accountant will be responsible to the Divisional Accountant, and his duties will include the general supervision of a punched card installation, handling Costs, Wages, Hire Purchase, and miscellaneous matters.

Applicants should hold an accounting qualification and have the ability to supervise and control staff, preference being given to a candidate with experience in the development of management accounting techniques.

The appointment is pensionable, and the successful applicant will be required to pass a medical examination.

Applications stating age, and giving details of qualifications, experience, present position and salary, together with the names of two referees, should be submitted to reach the undersigned not later than July 6, 1956.

A. GWYNNE DAVIES,
Secretary.

Beverley House,
University Road,
Leicester.
June 11, 1956.

EAST MIDLANDS GAS BOARD

SHEFFIELD AND ROTHERHAM DIVISION
DEPUTY INDUSTRIAL GAS ENGINEER

APPLICATIONS are invited for the position of DEPUTY INDUSTRIAL GAS ENGINEER, Sheffield and Rotherham Division, at a commencing salary of not less than £1,050 per annum.

Candidates should be fully qualified, with a wide knowledge of industrial processes, ability to develop applications to meet consumers' technical requirements, practical experience in the design, installation, operation and maintenance of all types of industrial furnaces, and be conversant with the special furnace atmospheres used in both ferrous and non-ferrous processes. They should be corporate members of the Institute of Fuel, or possess an equivalent qualification.

The post is pensionable, and the successful candidate will be required to pass a medical examination.

Applications stating age, education, experience and qualifications, together with the names of two referees, should reach the undersigned by July 9, 1956.

A. GWYNNE DAVIES,
Secretary.

Beverley House,
University Road,
Leicester.
June 15, 1956.

DESIGNER DRAUGHTSMAN.—Preferably with experience in Industrial Pipework layouts, required for company with Headquarters in the North West. Apply: No. 286, *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

EASTERN GAS BOARD

(TOTTENHAM DIVISION)
CHEMIST—RESEARCH LABORATORY, WILLOUGHBY LANE WORKS

APPLICATIONS are invited for the appointment of a CHEMIST (male) in the Research Laboratory at Willoughby Lane Works.

Applicants should hold a B.Sc. degree in Chemistry, or equivalent qualification and previous experience in the gas, fuel or heavy chemical industries will be an advantage, but is not essential. The successful applicant will be required to work under the supervision of the Research Chemist.

The salary will be in accordance with Grade A.P.T. 8 (Metropolitan)—£740 to £820 per annum—of the National Salary Scales for Gas Staffs.

The successful candidate will be required to undergo a medical examination and, unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required to join the Board's Staff Pension Scheme.

Applications, stating age, education, training and experience, should be addressed to the Divisional Personnel Manager, Eastern Gas Board (Tottenham Division), Woodall House, 658, Lordship Lane, Wood Green, N.22, so as to arrive within fourteen days of the appearance of this advertisement.

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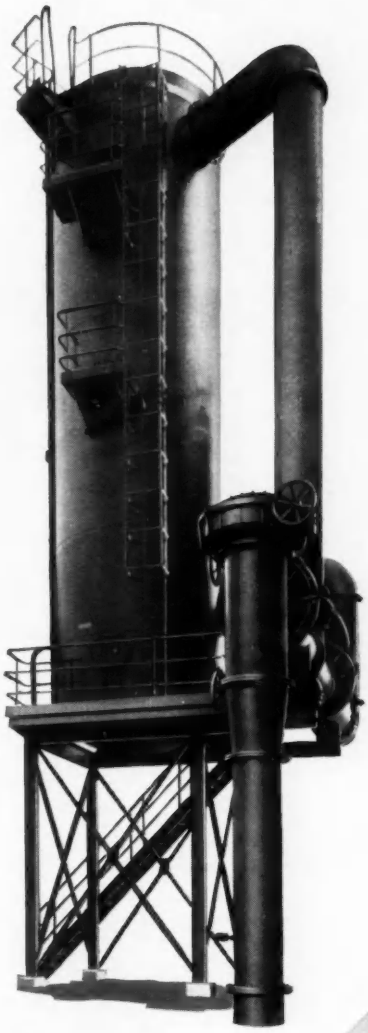
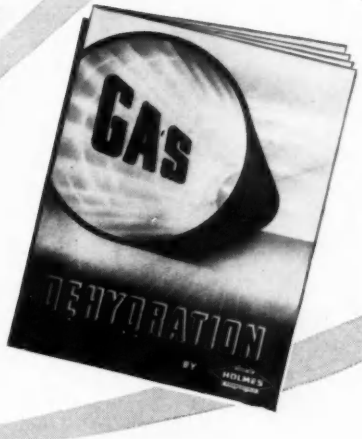


DEHYDRATION BEFORE TRANSMISSION

In the past nearly all Gas Dehydration Plants have been supplied for operation before local distribution. With the modern development of high pressure grid distribution schemes, some plants treat the gas before transmission. The above illustration is one of these; it shows a Counter Current Type Gas Dehydration Tower capable of working up to 25 lbs. per sq. in. gauge. Capacity 24 million cubic feet per day.

Full details contained in publication Number 38/5



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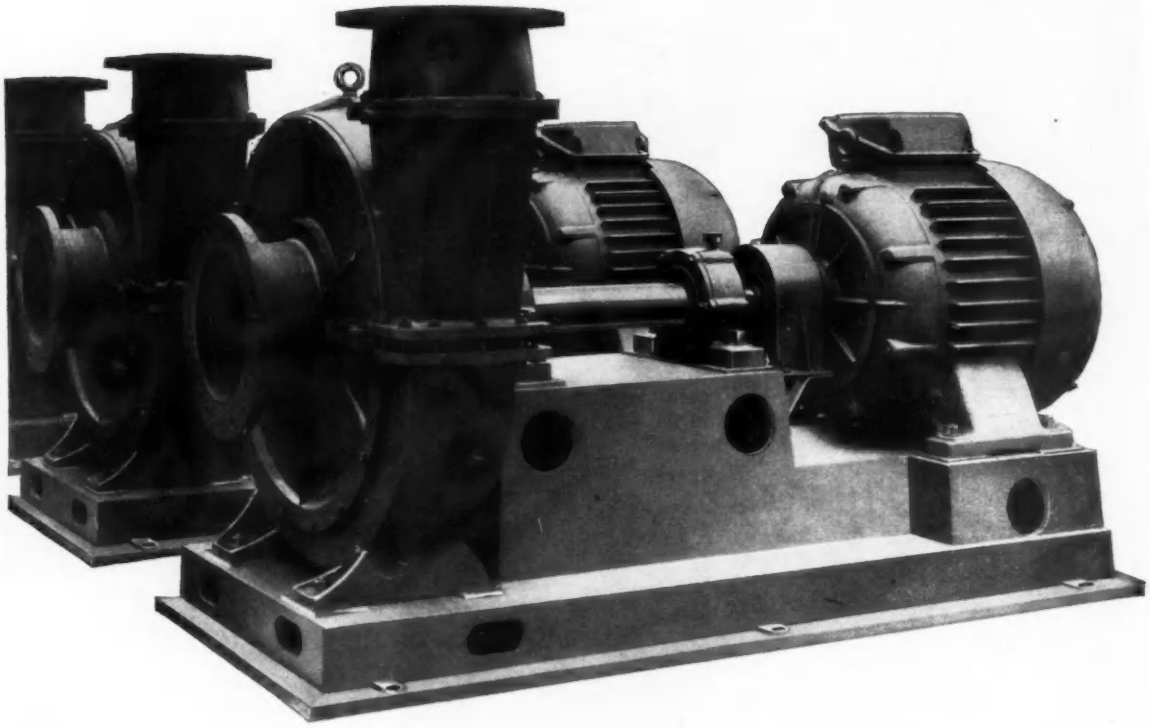
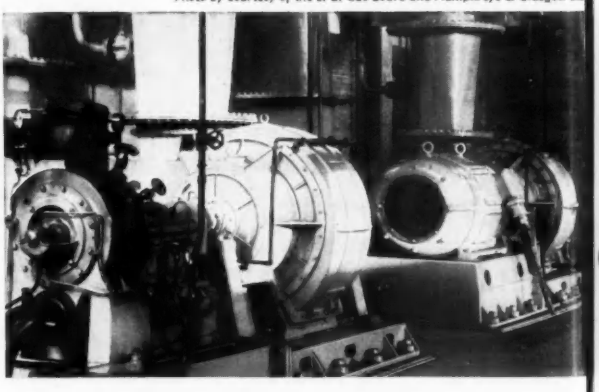


Gas Boosters?

Photo by courtesy of the S. E. Gas Board and Humphreys & Glasgow Ltd



EXAMPLES of gas boosting fans with cast iron casings are illustrated here. They represent the results of special attention to the design and development of robust, trouble-free boosters over the years. This experience provides fans for handling volumes of 5,000 to 1½ million cubic feet of gas per hour at pressures up to several pounds per square inch.
When the time comes you'll find there's no easier way to solve your air or gas moving problem than to put it to Keith Blackman.

contact **Keith Blackman Ltd**
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T.A.722

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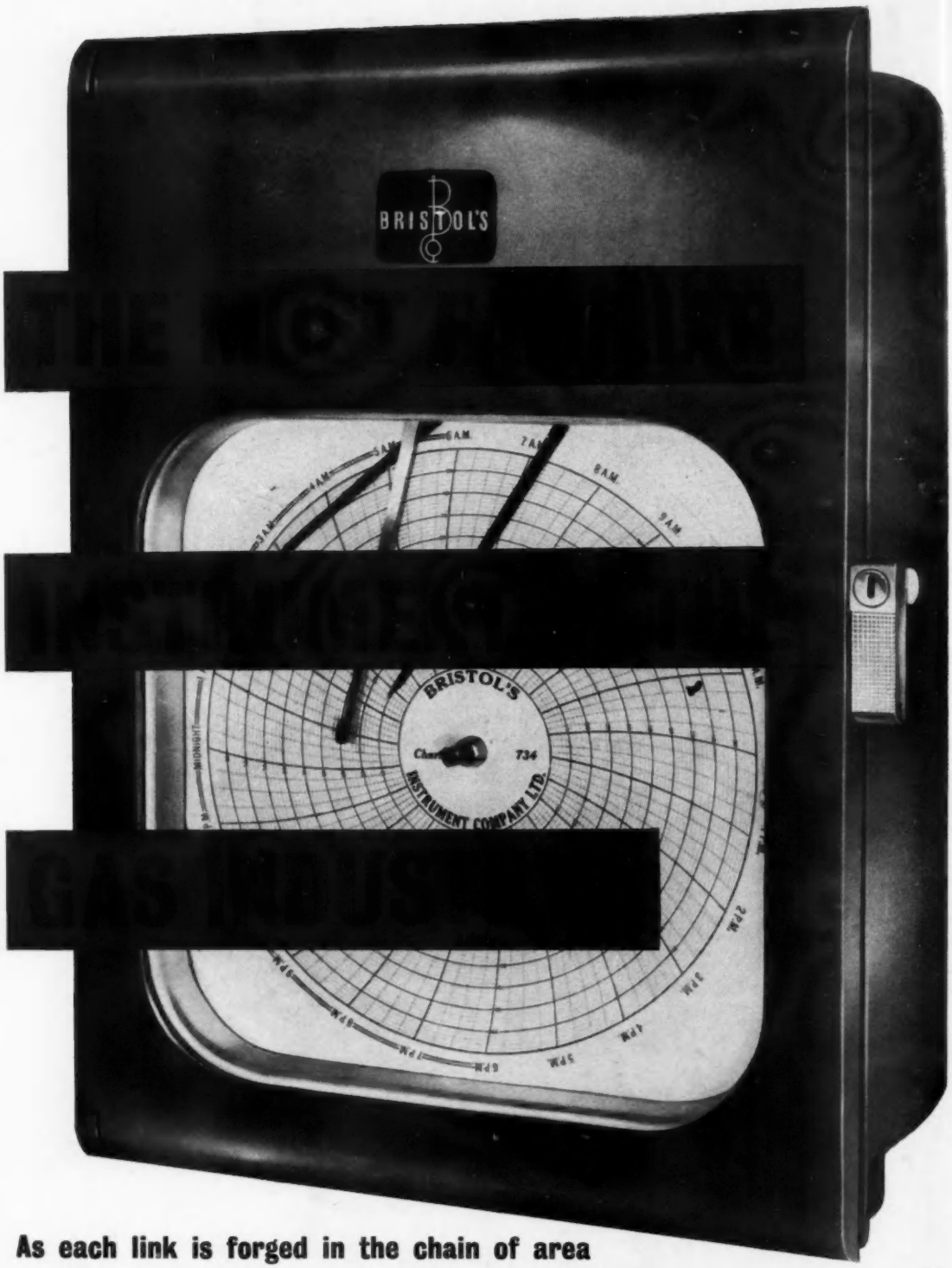

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